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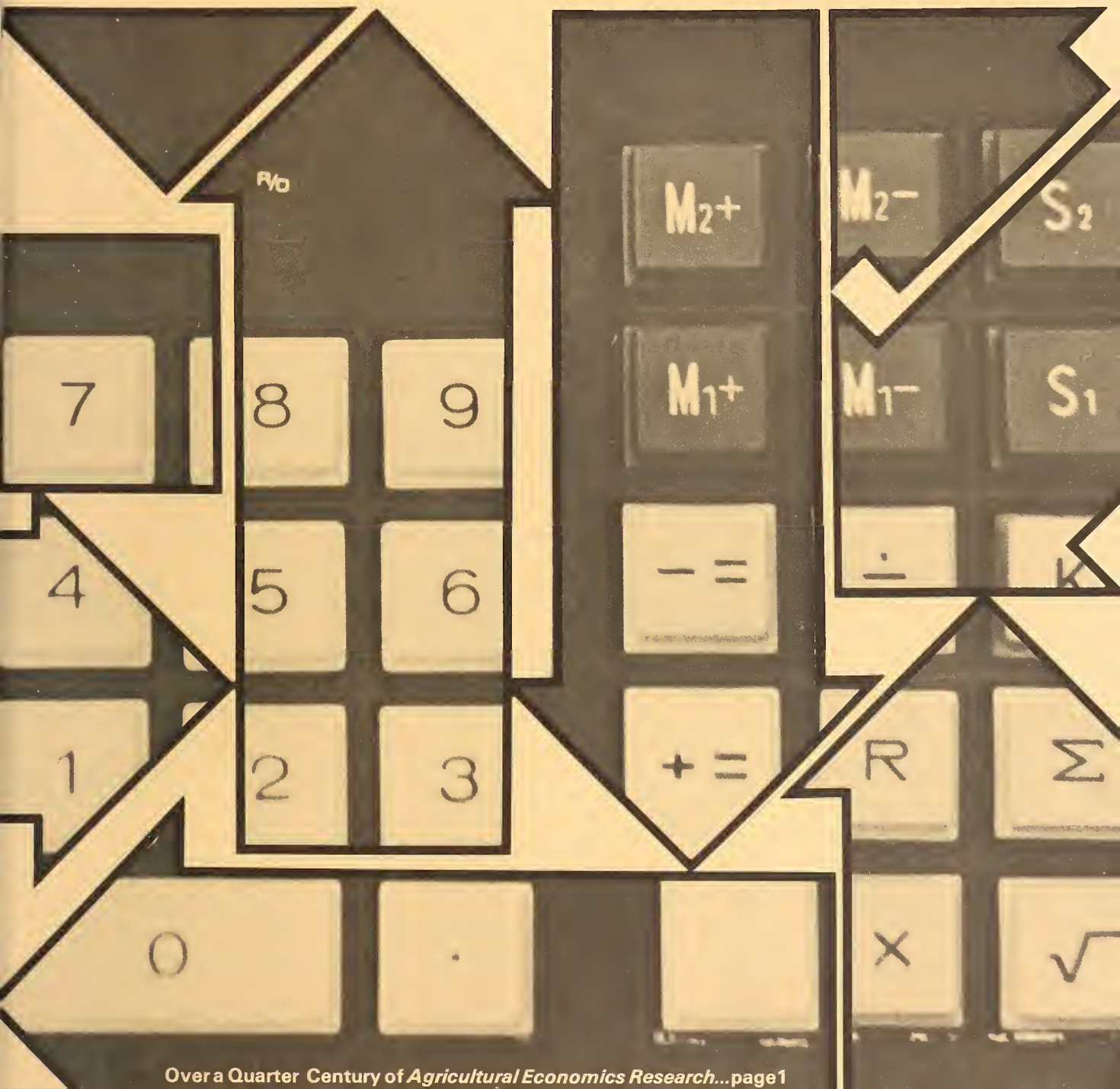

Over a Quarter Century of *Agricultural Economics Research*...page 1

AGRICULTURAL ECONOMICS RESEARCH

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In this issue

Over a Quarter Century of *Agricultural Economics Research*

By J. B. Penn

The origins and performance of this journal over a 27-year period are reviewed relative to its initial guidelines. Editorial staff, subject content, author affiliation, and distribution are treated, tracing the evolution of economic research from the seminal Bureau of Agricultural Economics to the present-day Economic Research Service.

Keywords: *Agricultural Economics Research* journal; Economic Research Service; research dissemination.

INTRODUCTION

The appearance of the July-October 1975 issue of *Agricultural Economics Research* (AER) completes its 27th year as a medium for publication of the technical research of the Economic Research Service (ERS), its predecessor agencies, and cooperating agencies within the U.S. Department of Agriculture (USDA). First appearing in 1949, this journal served the Bureau of Agricultural Economics (BAE) until its fragmentation in late 1953. AER continued, under the sponsorship of the Agricultural Marketing Service (AMS), and later under the joint sponsorship of AMS and the Agricultural Research Service (ARS). ERS has issued the journal since 1961. Over the years, it has grown into a highly respected and widely disseminated journal reporting economic and statistical research of ERS and cooperating agencies.

USDA has a history of continually evaluating its publications and of initiating changes that best serve its information dissemination function. For example, previous journals which had achieved high standing and were discontinued for economic and other reasons are *Agricultural Science Review* (1962-73), *Journal of Agricultural Research* (1913-46), *Experiment Station Record* (1889-1946), and *Land Policy Review* (1938-47).

These latter three journals are in a sense all precursors of AER, since they served as outlets for economic-related articles during the formative stages of the agricultural economics discipline. The *Experiment Station Record* chronicled early agricultural research for 57 years until the scope of State experiment station research became so vast that the Office of Experiment Stations (now the Cooperative State Research Service (CSRS)) could no longer cope with publishing the results of such research (*5*). Likewise, the general agriculture *Journal of Agricultural Research* filled a useful niche until its role was taken over by the growing number of specialized discipline journals. *Agricultural Science Review* of CSRS attained high standing as a science journal serving as a forum for critical review and evaluation of one area of a scientific discipline. It was discontinued in mid-1973 after 11 years of publication. Because of rising publication costs, it was felt that information funds should be used mainly to carry the story of agricultural science to the public at large (*5*). *Land Policy Review* is perhaps the main forerunner of AER. It was first published by the BAE as a bimonthly in 1938, replacing the *Land Policy Circular* begun in 1935. The *Review* was concerned with land policies and land matters across several disciplines. However, land economics problems, in the thirties and early forties, gave way to problems of a differing nature, and the need for that kind of a forum seemed less imperative. The *Review*, which had become a quarterly, was discontinued in 1947.

Partly with this tradition in mind—the periodic evaluation of existing publications, rising publication costs, the recent emergence of new professional journals, and possible tradeoffs in effectiveness between AER and other forms of publication—ERS Administrator Quentin West initiated a review of AER's purpose, focus, and policies in early 1975. The author's participation in this review prompted the interest in AER that has resulted in this article.

PERFORMANCE

Purpose and Scope

Agricultural Economics Research began in 1949 to provide the Bureau of Agricultural Economics a "medium for the publication of technical articles." O. V. Wells, in the first article in the new journal (*6*), set forth the purposes and editorial policy which have, with minor modifications, guided it since. Wells listed three general fields for articles: (1) results or findings of research within the Bureau, (2) new research methods or techniques being developed, as well as critical discussions of old techniques in regular use, and (3) new or expanding areas of research or statistical fact gathering. Acknowledging the role of statistics gathering, he suggested State statisticians and members of their staffs as "fruitful sources for items falling in the second general field" (see above). The statisticians were members of BAE at that time, and the close relationship to AER has continued, even after the statistics-gathering functions were placed in separate agencies—first, the Agricultural Research Service and later, the current Statistical Reporting Service (SRS).

The policy with respect to author-contributors was also set out by Wells in that initial article:

> . . . we shall consider articles from workers who are cooperating, or working under contract, with the Bureau. Such articles can be written jointly by a member of the Bureau and the cooperating or contracting individuals in the other organizations or over the signature of some single individual, who may be an employee either of the Bureau or the other agency, e.g., a State Agricultural College (*6*).

This policy continues and, in fact, is a condition of the authorization and funding from the Office of Management and Budget (OMB).

From the start, the new journal carried reviews of books focusing upon research or statistical methods and applied agricultural economics research. Such reviews have continued to be a part of the journal. A listing of recently released research and statistical reports was also carried but it was discontinued in 1967 (Vol. 19, No. 2). The number of new reports had become too numerous to list and they were being adequately listed elsewhere.

Several other issues were treated in the perceptive early statement of Wells. He noted explicitly the relation of AER to other journals; AER was not designed to be competitive with publications of the natural sciences or with professional journals, such as the *Journal of Farm Economics*. Further, articles dealing "directly with agricultural policy" were specifically excluded. These were felt to represent personal opinions rather than official statements and were left to "outside professional journals." This publication policy has been leniently interpreted not to exclude economic analyses of agricultural policies, which have appeared in AER from time to time. But articles that are clearly politically sensitive remain unacceptable. Wells also raised issues of cost, which he estimated to be minimal, approximating the cost of a "fair-sized technical bulletin." The expense was thought to be justified since AER was intended to serve a wide audience and to report on several projects in each issue. Prompt dissemination of results was also a justification for AER—here, he cited the lengthy time requirements for publication of bulletins—a justification valid today.

Wells also considered the scope of agricultural economics research. He defined it "in the widest sense to cover all work ordinarily carried forward by the Bureau, including work done in cooperation with other agencies such as State Agricultural Colleges and State Departments of Agriculture" (*6*). Specifically, this definition covered the entire field of agricultural estimates or statistics, rural social studies, and research on such subjects as prices, marketing, land economics, farm finance, and farm management.

Finally, as justification for both time devoted to preparation of articles and to the journal itself, Wells stated:

> Agricultural economics work is carried on in the public interest and every researcher or statistician, regardless of his field, does have a responsibility for seeing that his material is prepared in such a way as to be readily accessible to his fellow workers and to the public (*6*).

The general purposes, scope, and relation to other publications as stated by Wells remain largely relevant and in effect today.

Organization and Operation

At its inception, *Agricultural Economics Research* was staffed by two editors. This practice has continued except for two issues which had three editors. In 1955 (Vol. 7, No. 3), two assistant editors were added to the staff, and this number alternately varied between two and four until the position of assistant editor was abolished with the last issue of 1965. The book review editor selected for the first issue of 1962 served through 1975, when the position was discontinued. An official editorial board was instituted in 1966; its membership, varying in number from six to eight, has generally represented the ERS divisions and it has included a representative from SRS.

Reflecting the widespread participation in AER's operation, a large number of people have served in the various staff positions in the past 27 years. A larger number have unofficially served as reviewers, persons encouraging manuscript submissions, and the like. AER has been served by 11 editors, 8 assistant editors, 1 book review editor, and 16 editorial board members (app. table 1).

During its 27 years, AER has appeared as 106 issues (2 volumes have contained combined numbers) (table 1). These issues comprise 2,700 pages of 335 articles by 485 authors and 654 book reviews by approximately that many reviewers (rare multiple-person reviews have appeared.[1] Of total pages, 75 percent was devoted to articles, 19 percent to book reviews, and 6 percent to the listing of publications.

The 485 contributing authors represent a diversity of organizational affiliations both within and outside the Agency.[2] Considering the statement of policy on authorship noted earlier, the number of authors from other Government agencies and universities is larger

[1] An interesting sidelight from table 1 arises from noting the average number of authors per article for 1950-75 by 5-year intervals (except for the last period, which contains 6 years). These averages are 1.38, 1.28, 1.41, 1.52 and 1.74. A plausible explanation for the increase in the later periods is the emphasis on the task force and team approach to research as opposed to the single-person project approach generally prevalent in the earlier periods. However, other explanations are also tenable. The increase could reflect changes over time in which the rank-experience distinction among professionals has become less pronounced. That is, a more generous senior staff shares authorship with junior staff; a higher caliber junior staff merits coauthorship; coauthorship is extended to junior staff as a substitute for salary rewards and so on.

[2] "The Agency," as used in this article, refers to ERS and predecessor agencies.

Table 1. Articles, authors, book reviews, and pages, *Agricultural Economics Research*, 1949-75

Year	Articles			Reviews		Listing of publications
	Articles	Authors	Pages	Reviews	Pages	Pages[a]
			Number			
1949	17	19	119	18	20	7
1950	15	21	114	16	16	8
1951	16	20	119	24	27.5	6.5
1952	14	18	106.5	28	32.5	9
1953	16	23	75.5	21	28	11
1954	13	20	111	13	14.5	8.5
1955	12	15	78	25	28	15
1956	14	19	104	24	27	10
1957	15	17	114	25	29	14
1958	10	12	109	27	27	14
1959[b]	10	15	105	20	23	14
1960	10	13	77	26	30	13
1961	12	14	92.5	35	33.5	15
1962	12	16	114	28	25.5	15.5
1963	12	21	101	26	28.5	16.5
1964	10	15	83	30	24	21
1965	11	17	90	27	25	18
1966	14	23	107	23	25	12
1967	11	15	83	32	34	[c]5
1968	12	19	117	23	27	
1969	14	20	96	23	25	
1970	14	24	96	25	24	
1971	11	20	83	34	30	
1972	10	16	88	27	30	
1973	10	18	97	20	20	
1974	10	17	97	16	18	
1975[b]	10	18	123	18	19	
Total	335	485	2,699.5	654	691	233

[a]Count includes back cover. [b]Vol. 11, Nos. 2 and 3, and Vol. 27, Nos. 3 and 4 are combined issues. [c]Listing of "Recent Research Publications" was discontinued with Vol. 19, No. 2.

than might be expected.[3] A breakdown of author affiliation among units within the Agency, other Government agencies, and universities appears in table 2.[4] A proportional summary of author affiliations by organization is shown in table 3.

Subject Coverage

To show coverage of subjects in AER over the past 27 years, the 335 articles were classified by subject category.[5] Table 4 presents percentage distribution by subject category for 1949 and by 5-year periods (except the last period) through 1975. The pattern revealed generally correlates with the focus areas set forth initially by Wells. Research methodology, commodity studies, and functional analyses have continuously been the major subject areas. Other areas have varied considerably over the years, reflecting changing priorities and emphases.

The research methods category has consistently comprised roughly one-fifth of the AER articles, supporting the initial justification for the Journal as a technical forum for economists. The early articles in this area primarily concerned data gathering and preparation

[3]The categorization of authorship among institutions is not precise. The intent was to classify authors by their organizational unit at the time the reported work was done. In most cases, classification was possible as the author identification on the article indicated whether authors had changed organizations.

[4]The large number of units listed for the Agency reflects organizational changes from 1949 to date. (For an excellent history of economic research in USDA, see *Agr. Econ. Res.* Vol. 27:3-4, July-October, 1975, pp. 53-72.

[5]Any classification of articles into exclusive subject categories is, of course, an inherently arbitrary and subjective process. This classification is not argued to be superior to any other. Any bias present is thought to be constant across the range of classifications; thus any existing trends would not be obscured.

Table 2. Author affiliation, *Agricultural Economics Research*, 1949-75

Institution	1949-53	1954-61[a]	1961-75
		Number	
Agency			
Divisions:[b]			
Commodity economics			12
National economic analysis			16
Economic and statistical analysis			30
Farm production economics			35
Marketing economics			35
Natural resource economics			9
Economic development			11
Foreign development and trade			4
Farm economics			8
Regional development economics			1
Development and trade analysis			2
ERS, Office of the Administrator			3
ERS[c]			10
AMS		79	
ARS		17	
BAE	74		
Other USDA			
AMS			1
ARS	1		2
Office of the Secretary	1		1
SRS			9
Forest Service	2	1	2
Other Government			
Bureau of the Budget	1		
Bureau of the Census	7		
Congressional staff	1		
Department of Treasury			1
Health, Education, and Welfare			1
International Agricultural Development Service			1
Public Health Service		1	
Industry	3	3	
Other			
Ford Foundation			2
West German Government		1	
Universities and colleges			
Cornell Univ.			1
Delaware State College			1
Howard Univ.	1		
Iowa State Univ.	1	3	5
Michigan State Univ.		1	
Montana State Univ.		1	
North Carolina State Univ.	1	1	5
Ohio State Univ.			1
Oklahoma State Univ.			6
Oregon State Univ.		1	
Penn State Univ.	1		2
Purdue Univ.	2		3
Univ. of Arizona			1
Univ. of California (Berkeley)		1	3

Continued

Table 2. Author affiliation, *Agricultural Economics Research*, 1949-75—continued

Institution	1949-53	1954-61[a]	1961-75
		Number	
Universities and colleges—continued			
Univ. of California (Davis)	1	2	14
Univ. of Chicago		1	
Univ. of Delaware			1
Univ. of Georgia			5
Univ. of Guelph			2
Univ. of Hawaii			2
Univ. of Idaho	1		
Univ. of Illinois	1	1	4
Univ. of Michigan			1
Univ. of Minnesota			9
Univ. of Nebraska			1
Univ. of Pennsylvania		1	
Univ. of West Indies			1
Univ. of Wyoming			1
VPI and State Univ.	1		1
Washington State Univ.			3
West Virginia Univ.	1		

[a]Includes Nos. 1 and 2, Vol. 13, 1961. [b]Refers to divisions existing since ERS was formed which had authors of AER articles. [c]Author not further identified.

Table 3. Author affiliation summarized, *Agricultural Economics Research*, 1949-75

Institution	Number	Percent
ERS and predecessor agencies	346	71.3
Other USDA agencies	20	4.1
Other U.S. Government	13	2.7
Industry	6	1.2
Universities and colleges	97	20.0
Other	3	.6
Total	485	100.0

activities, such as survey sampling procedures, respondent bias, treatment of nonrespondents, and missing data. Also, these and other early articles reflected the close association with physical and biological sciences, true of the profession in general and reflecting its origins. Later methodological articles considered analytical techniques, treating statistical and deterministic methods such as least squares, mathematical programming, simulation, and input-output.

The initially recommended emphasis of reporting research results also emerges from the classification. The commodity studies category contained a large proportion of the articles. This share has declined somewhat since the 1950's when it reached a peak, constituting fully half of all articles published in 1955-59. Both marketing and production economics articles have comprised a significant proportion but one somewhat erratic over time. The percentage of marketing articles was relatively large in the 1960's but it has since declined. The share of production economics articles was relatively large in the late 1960's, declining thereafter. Ironically, many persons from the Farm Production Economics Division have contributed (table 2). But a large share of their articles fall primarily into the commodity studies or methodology category, and they were not included in the production economics category.

Resource economics articles have appeared steadily over time but relatively more often in the first than the second half of the 1950's and 1960's. Likewise, domestic development articles have consistently appeared and they are in a relatively flourishing period now. Foreign development articles did not appear until the latter part of the 1950's; in the periods shown, their appearance has been erratic. This behavior, of course, indicates the rather recent development of research programs in areas of foreign development, trade, and competition within ERS.

Given the role of economic research in agricultural policy formation and evaluation, the scarcity of articles in this category may be somewhat surprising at first. However, as noted earlier, Wells excluded such articles.[6]

[6] Wells did not explicitly define "policy." The categorization used here implies some definition of the term. No rigorous definition will be attempted, however, but analyses of specific programs of a policy—for example, farm policy programs for feed grains—are included in other categories which reflect content of the particular analysis.

Table 4. Articles by subject category, *Agricultural Economics Research*, 1949-75

Subject category	1949	1950-54	1955-59	1960-64	1965-69	1970-75
			Percent			
General agricultural economics	17.6	5.4	3.3	1.8	6.5	6.2
Agricultural policy	0	0	3.3	0	3.2	7.7
Commodities: supply, demand, prices	5.9	33.8	50.8	17.9	17.7	20.0
Marketing, storage, distribution	11.8	6.8	6.6	21.4	16.1	9.2
Production economics	11.8	5.4	1.6	14.3	8.1	4.6
Farm finance, capital, credit	0	5.4	6.6	7.1	8.1	7.7
Resource economics	5.9	8.1	3.3	7.1	6.5	4.6
Domestic development	0	6.8	8.2	7.1	4.8	10.8
Foreign development	0	0	1.6	0	8.1	3.1
Research and extension methods	41.2	24.3	13.1	19.6	19.4	21.5
Other[a]	5.9	4.1	1.6	3.6	1.6	4.6
Total	100.0	100.0	100.0	100.0	100.0	100.0

[a]An example would be this article.

Note: Components may not sum to totals because of rounding.

This exclusion reflects the controversy of the last half of the 1940's over BAE's role in the Department. Was it to supply facts and figures, conduct analyses and retain a neutral stance, or be a policy planning and advocate agency closely tied to the Secretary? BAE had become the object of criticism in the 1940's for some of its planned programs, such as "Conversion of the Cotton South" and certain sociological studies also conducted in the South. Heavy criticism came from the American Farm Bureau Federation and several influential Congressmen. As a consequence, the BAE Chief resigned in 1946 and the budget appropriations were severely reduced for several years of this period. Wells became the chief in 1946 and he hoped to keep BAE out of controversy, to quiet the critics, and to enlarge appropriations. The tendency of *Land Policy Review* to treat politically sensitive policy issues may have hastened its demise during this period of controversy.

In subject coverage, AER has generally followed the original focus and scope defined by Wells; within this, the articles appearing have reflected the major thrusts of BAE and successor agencies. Also, the articles have reflected the changing priorities of the Congress and USDA. Distribution of articles in 1961-70 (and, to some degree, author affiliation within ERS) roughly parallels the project appropriations of the Congress for ERS in those years (table 5). (Probably a lag occurs between the time a shift in appropriations takes place and the time an article appears on the subject area that is receiving more funds. Such a lag would not be fully reflected in the short timespan shown in table 5). Appropriations for production economics research expanded considerably during the 1960's, appropriations for marketing declined somewhat, and those for foreign and domestic development remained relatively stable with some slight increase. Also, the subjects of articles appearing in AER somewhat reflect changing interest areas of the agricultural economics profession in general.

For 1953-72, the subject coverage of AER was compared with that of the *American Journal of Agricultural*

Table 5. Appropriated funds by projects, Economic Research Service, selected years, 1961-70

Year	Total	Farm economics		Marketing economics		Domestic and foreign economics	
	$1,000		*Percent*	*$1,000*	*Percent*	*$1,000*	*Percent*
1961	8,997	3,175	35.3	3,362	37.4	2,460	27.3
1963	8,842	3,202	36.2	2,971	33.6	2,669	30.2
1965	11,160	5,222	46.8	3,032	27.2	2,905	26.0
1967	12,336	5,738	46.5	3,434	27.8	3,164	25.6
1969	10,146	6,258	61.7	3,365	33.2	3,551	35.0
1970	14,881	6,972	46.9	3,839	25.8	4,070	27.3

Economics (AJAE) (table 6). Subject categories are identical to those Holland and Redman (*4*) used, except for the "other" category for AER, which contains articles that do not seem to fit elsewhere.

The number of articles on general agricultural economics has been erratic for both journals; AER has carried a slightly larger proportion.[7] AJAE has contained a significantly larger proportion of policy articles, as would be expected. Though ERS does large amounts of policy related research, the work is often internal, generally unpublished staff analyses for Department or Congressional use. AER has consistently carried a larger share of articles on commodity and marketing subjects and fewer articles treating production economics. The proportions of articles in the finance, capital, and credit and resource areas have been much closer for the two journals. AJAE has continuously devoted a higher proportion to domestic and foreign development articles. As for the methodology category, it includes extension and teaching for AJAE and primarily only methodology (including a small number of outlook and situation articles) for AER. In the first and third periods shown in table 6, AER had a significantly greater proportion of articles in this category but substantially fewer than AJAE in the second period.

This comparison of the two journals generally reflects the similarity of ERS's interests to those of the profession as a whole and also ERS's more narrow or specific mission, clientele, and orientation.[8] AJAE receives articles from a generally larger population of authors than does AER, from a wider range of universities, foundations, governments, and other international organizations, as evidenced by the consistent 10-15 percent of articles appearing on international research. However, the growing interrelatedness of all economic sectors and the consequent general expansion of ERS research programs into many new areas in recent years is evidenced by the more even distribution of articles among all categories, lessening the divergence in research reported by AER and AJAE.

Audience Coverage

Distribution of the results of research by ERS and cooperating agencies through *Agricultural Economics Research* is literally worldwide. It is impossible to

[7] Contributions by USDA authors comprise a significant proportion of total contributions to AJAE in this period. Thus, some of the trends or other indications from the AJAE groupings reflect what USDA and ERS authors were writing about during this period. Also, Agency personnel have spent varying proportions of their time working as staff economists, which influences the quantity and subject of their submissions to both journals.

[8] A factor not treated here but which influences to some extent the number and content of AER articles is the availability of other publications within the Department and Agency to researchers as outlets. The existence of USDA and ERS series (Technical Bulletins, ERS Series, AER Series), situation and outlook reports, *Farm Index*, the *Agricultural Finance Review*, and others influences submissions to AER. The same situation exists, of course, with outside publications such as the AJAE and the regional professional association journals.

Table 6. Articles by subject category, *Agricultural Economics Research* and *American Journal of Agricultural Economics*, 1953-1972[a]

Subject category	1953-62		1963-67		1968-72	
	AER	AJAE[b]	AER	AJAE[b]	AER	AJAE[b]
	Percent					
General agricultural economics	1.6	5.5	5.2	2.1	9.8	5.1
Agricultural policy	1.6	9.6	1.7	10.2	4.9	7.4
Commodities: supply, demand, prices	38.7	15.3	24.1	10.2	14.8	9.1
Marketing, storage, distribution	10.5	8.5	19.0	14.6	11.5	10.3
Production economics	4.8	22.3	6.9	17.1	8.2	17.7
Farm finance, capital, credit	7.3	2.7	1.7	1.8	8.2	3.3
Resource economics	4.8	7.0	6.9	5.2	6.6	9.5
Domestic development	8.1	8.6	6.9	11.2	8.2	15.4
Foreign development	.8	10.4	6.9	14.5	3.3	12.5
Research teaching and extension methods	16.9	10.2	19.0	13.0	24.6	9.8
Other[c]	4.8		1.7		0.0	
Total	100.0	100.0	100.0	100.0	100.0	100.0

[a] The distribution shown for AJAE is derived from the number of pages in each category since distribution by number of articles was not available. Distribution for AER is from number of articles only. [b] Source: (*4* p. 789). [c] An example would be this article.

Note: Components may not sum to totals because of rounding.

reasonably estimate the number of people using AER. But assuming even a very conservative "multiplier" effect on library and institutions' subscriptions, the number is obviously very large. To obtain a clear notion of AER distribution, the subscription list as of March 1974 was examined. [9] Subscribers were classified first into identity groupings; banks, libraries, embassies, and so on. Foreign address subscriptions were separated from the total list. The total list was also subdivided into paid (foreign and domestic) and free (foreign and domestic) groupings.

The total subscription list of AER numbered 3,184 as of March 1974[10] (table 7). Libraries, 25 percent of the total, comprised the largest single group. The combined groups of land grant universities and other universities and colleges constituted 35 percent. The remainder broke out as all U.S. Government agencies (18 percent), farm organizations, agriculture-related and other businesses (17 percent), and private individuals, foreign governments, others, and unclassified (15 percent). By domestic and foreign addresses, the percentages were 64 and 36 respectively.

The foreign addresses, when subclassified according to general geographic areas, revealed a worldwide distribution (table 8). The largest groups were Western Europe (24 percent), Latin America (13 percent), Eastern Asia (12 percent), and Canada (12 percent).

The subscription list was also subdivided into paid and free lists (app. tables 2 and 3).[11] The paid list represents 41 percent of the total list (app. table 2). Of this number, 58 percent are domestic subscribers and 42 percent are subscribers with foreign addresses.

[9] The classification of the subscription lists shown was completed by Allen B. Paul, former editor of AER.

[10] For perspective, total AJAE circulation is currently about 5,900: regular members (3,800), junior members (440), subscriptions (1,600), and sustaining members (22) (*1*).

[11] Publication and appropriation approval by OMB specifies a total number of pages per year for the quarterly issues and total number of subscriptions which may be sent without charge (currently, 2,000). The free list has been compiled on a "first come-first served" basis; once full (as now), no additions can be made. Revenue from the paid subscriptions does not accrue to ERS but to the Superintendent of Documents at the U.S. Government Printing Office, for placement into the general revenue fund.

Table 7. Subscriptions to *Agricultural Economics Research*, March 1974

Subscriber	Total		Domestic		Foreign	
			Number[a]			
ERS	135	(2)	135	(2)		
Other USDA (Washington, D.C.)	103	(0)	103	(0)		
Other USDA (field)	71	(5)	71	(5)		
State agricultural statisticians	23	(0)	23	(0)		
Other Federal Agencies	186	(27)	87	(19)	99	(8)
Congressional offices	5	(0)	5	(0)		
Land grant universities	487	(32)	487	(32)		
Other universities and colleges	633	(335)	220	(91)	413	(244)
State and local government	59	(12)	38	(3)	21	(9)
Libraries	82	(82)	34	(34)	48	(48)
Farm organizations	19	(1)	11	(0)	8	(1)
Business and trade organizations	52	(13)	28	(5)	24	(8)
Banks	82	(33)	49	(25)	33	(8)
Brokerage houses, management firms	57	(6)	57	(6)		
Media	43	(1)	35	(0)	8	(1)
Other private businesses	335	(85)	302	(83)	33	(2)
Private nonprofit organizations	39	(15)	26	(9)	13	(6)
Embassies	17	(6)	14	(6)	3	(0)
Foreign governments	283	(133)	4	(0)	279	(133)
International organizations	13	(7)	9	(5)	4	(2)
Private individuals	326	(0)	299	(0)	27	(0)
Unclassified[b]	134	(13)	12	(2)	122	(11)
Total	3,184	(800)	2,049	(327)	1,135	(481)

[a] Numbers in parentheses represent libraries. [b] Chiefly because the foreign language barrier (Russian, for example), prevented ready identification of subscriber.

Source: Compiled by Allen B. Paul, ERS, August 1974.

Table 8. Foreign address subscriptions to *Agricultural Economics Research*, March 1974

Subscriber	Total	Canada	Latin America	Western Europe	Eastern Europe	Africa	Western Asia[a]	Southern Asia[b]	Eastern Asia[c]	Oceania	Undisclosed[d]
						Number					
ERS											
Other USDA (Washington, D.C.)											
Other USDA (field)											
State agricultural statisticians											
Other Federal Agencies	99	11	1		2	34	7	10	2		32
Congressional offices											
Land grant universities											
Other universities and colleges	413	47	53	121	30	33	14	40	50	25	
State and local government	21	20								1	
Libraries	48	2	8	10	9	3	4	4	8		
Farm organizations	8	1	1						2	4	
Business and trade organizations	24	3	5	6			1	3	5	1	
Banks	33	2	16			1	1	8	3	2	
Brokerage houses, management firms											
Media	8			5	1	1		1			
Other private businesses	33	5		19				1	5	3	
Private nonprofit organizations	13		3	4				4	2		
Embassies	3		2	1							
Foreign governments	279	32	48	65	33	27	8	31	17	16	2
International organizations	4			2					1	1	
Private individuals	27	6	8	10					2	1	
Unclassified	122	1	5	33	35	1	3	9	35		
Total	1,135	130	150	276	110	100	38	111	132	54	34

[a]Iran, Iraq, Israel, Jordan, Lebanon, Saudi Arabia, Syria, Turkey. [b]India, Pakistan, Bangladesh, Indonesia, Ceylon.
[c]China, Japan, Taiwan, Philippines, Korea, Hong Kong. [d]Usually means only an APO address given.

The paid foreign subscriptions were also classified by geographic area (app. table 3). The free subscription list was subcategorized by type and residence of subscriber (app. tables 4 and 5). The free list contained 69 percent domestic and 31 percent foreign addresses. The free list with foreign addresses was also classified by geographic areas (app. table 5).

ASSESSMENT

AER appeared at a time when the agricultural economics profession was entering an era to be marked by the widespread adoption of new techniques and utilization of the electronic computer. The journal provided a more specific medium for technical communication among economists, specifically economists oriented to Government research. As to the initially stated purposes and functions, AER appears to have fulfilled its role well, largely because of the excellent service of its staff.

In recent years, additional means for professional communication have appeared, notably journals and proceedings of the regional professional associations and many subject-oriented professional journals. ERS Administrator Quentin West solicited comments and suggestions about these additions and the role of AER in early 1975. Almost all responses supported continuation of the journal. The review committee for AER later appointed by West specifically examined the journal's purpose, focus, and relation to other ERS and professional publications (*2*). The committee suggested that AER's functions are somewhat unique, that its role is not duplicated by other publications. The recommended changes in policies and procedures contained in the committee report and accepted by the administrator should further increase the journal's effectiveness. It is anticipated that the future role and contributions of *Agricultural Economics Research* will be as significant as those of its first quarter-century.

201-134 O - 76 - 2

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Appendix table 1. Staff of *Agricultural Economics Research*, 1949-75[a]

Staff	Position	Service					
		From			Through		
		Vol.	No.	Yr.	Vol.	No.	Yr.
Howard L. Parsons	Editor	1	1	1949	2	4	1950
Caroline Sherman	Editor	1	1	1949	4	1	1952
Herman M. Southworth	Editor	3	1	1951	7	2	1955
W. H. Scofield	Editor	3	1	1951	3	2	1951
Charles E. Rogers	Editor	4	2	1952	15	3	1963
James P. Cavin	Editor	7	3	1955	12	3	1960
R. P. Christensen	Assistant Editor	7	3	1955	11	1	1959
	Assistant Editor	14	1	1962	17	4	1965
	Editorial Board	18	1	1966	21	1	1969
Winn Finner	Assistant Editor	7	3	1955	12	4	1960
Kenneth Bachman	Assistant Editor	11	2 & 3	1959	12	3	1960
Rex F. Daly	Editor	12	4	1960	17	4	1965
M. L. Upchurch	Assistant Editor	12	4	1960	14	4	1962
Kenneth Ogren	Assistant Editor	13	1	1961	17	4	1965
Bruce W. Kelly	Assistant Editor	14	1	1962	17	4	1965
	Editorial Board	18	1	1966	21	1	1969
	Editorial Board	25	1	1973	27	3 & 4	1975
Wayne Rasmussen	Book Review Editor	14	1	1962	27	3 & 4	1975
Ronald L. Mighell	Assistant Editor	15	2	1963	17	4	1965
	Editor	18	1	1966	22	2	1970
	Editorial Board	22	3	1970	27	3 & 4	1975
Elizabeth Lane	Editor	15	4	1963	27	2	1975
W. B. Back	Editorial Board	18	1	1966	22	2	1970
Allan R. Bird	Editorial Board	18	1	1966	18	1	1966
R. E. Olson	Editorial Board	18	1	1966	18	3	1966
R. M. Walsh	Editorial Board	18	1	1966	24	2	1972
J. W. Willett	Editorial Board	18	1	1966	22	2	1970
Clark Edwards	Editorial Board	18	2	1966	27	3 & 4	1975
Allen Paul	Editorial Board	18	4	1966	20	3	1968
	Editor	22	3	1970	27	3 & 4	1975
Richard J. Crom	Editorial Board	20	4	1968	24	4	1972
William E. Kibler	Editorial Board	21	2	1969	24	4	1972
Carmen O. Nohre	Editorial Board	21	2	1969	24	4	1972
Anthony S. Rojko	Editorial Board	22	3	1970	27	3 & 4	1975
Roger Strohbehn	Editorial Board	22	3	1970	27	3 & 4	1975
Jimmy L. Matthews	Editorial Board	24	3	1972	27	3 & 4	1975
Judith A. Armstrong	Editor	27	3 & 4	1975			

[a]This tabulation assumes the editorial board listing in Vol. 26, No. 1 is erroneous.

Appendix table 2. Paid subscriptions to *Agricultural Economics Research*, March 1974

Subscriber	Total		Domestic		Foreign	
			Number[a]			
ERS	---		---			
Other USDA (Washington, D.C.)	---		---			
Other USDA (field)	7	(0)	7	(0)		
State agricultural statisticians	---		---			
Other Federal Agencies	32	(14)	18	(8)	14	(6)
Congressional offices	---		---			
Land grant universities	44	(5)	44	(5)		
Other universities and colleges	348	(216)	105	(74)	243	(142)
State and local government	16	(0)	16	(0)		
Libraries	56	(56)	24	(24)	32	(32)
Farm organizations	10	(1)	5	(0)	5	(1)
Business and trade organizations	20	(4)	14	(4)	6	(0)
Banks	49	(28)	34	(22)	15	(6)
Brokerage houses, management firms	48	(6)	48	(6)		
Media	13	(0)	12	(0)	1	(0)
Other private businesses	254	(81)	223	(79)	31	(2)
Private nonprofit organizations	14	(7)	12	(6)	2	(1)
Embassies	2	(2)	2	(2)		
Foreign governments	85	(45)	4	(0)	81	(45)
International organizations	3	(3)	3	(3)		
Private individuals	207	(0)	183	(0)	24	(0)
Unclassified[b]	105	(13)	12	(2)	93	(11)
Total	1,313	(481)	766	(235)	547	(246)

[a]Numbers in parentheses represent libraries. [b]Chiefly because the foreign language barrier (Russian, for example) prevented ready identification of subscriber.

Appendix table 3. Paid subscriptions to foreign addresses for *Agricultural Economics Research*, March 1974

Subscriber	Total	Canada	Latin America	Western Europe	Eastern Europe	Africa	Western Asia[a]	Southern Asia[b]	Eastern Asia[c]	Oceania	Undisclosed[d]
					Number						
ERS											
Other USDA (Washington, D.C.)											
Other USDA (field)											
State agricultural statisticians											
Other Federal agencies	14	1	1		2			3	1		6
Congressional offices											
Land grant universities											
Other universities and colleges	243	41	16	74	8	23	9	27	31	15	
State and local government											
Libraries	32	2	5	6	6	1	3	3	6		
Farm organizations	5	1	1						1	2	
Business and trade organizations	6	1	1					1	3		
Banks	15	1	10				1	2	1		
Brokerage houses, management firms											
Media	1			1							
Other private businesses	31	4		18				1	5	3	
Private nonprofit organizations	2		1						1		
Embassies											
Foreign governments	81	23	7	16	9	10	1	9		6	
International organizations											
Private individuals	24	6	6	9					2	1	
Unclassified	93	1	2	24	24	1	1	6	34		
Total	547	81	49	148	49	35	15	52	85	27	6

[a]Iran, Iraq, Israel, Jordan, Lebanon, Saudi Arabia, Syria, Turkey. [b]India, Pakistan, Bangladesh, Indonesia, Ceylon. [c]China, Japan, Taiwan, Philippines, Korea, Hong Kong. [d]Usually means only an APO address given.

Appendix table 4. Free subscriptions to *Agricultural Economics Research*, March 1974

Subscriber	Total		Domestic		Foreign	
			Number[a]			
ERS	135	(2)	135	(2)		
Other USDA (Washington, D.C.)	103	(0)	103	(0)		
Other USDA (field)	64	(5)	64	(5)		
State agricultural statisticians	23	(0)	23	(0)		
Other Federal Agencies	154	(13)	69	(11)	85	(2)
Congressional offices	5	(0)	5	(0)		
Land grant universities	443	(27)	443	(27)		
Other universities and colleges	285	(119)	115	(17)	170	(102)
State and local government	43	(12)	22	(3)	21	(9)
Libraries	26	(26)	10	(10)	16	(16)
Farm organizations	9	(0)	6	(0)	3	(0)
Business and trade organizations	32	(9)	14	(1)	18	(8)
Banks	33	(5)	15	(3)	18	(2)
Brokerage houses, management firms	9	(0)	9	(0)		
Media	30	(1)	23	(0)	7	(1)
Other private businesses	81	(4)	79	(4)	2	(0)
Private nonprofit organizations	25	(8)	14	(3)	11	(5)
Embassies	15	(4)	12	(4)	3	(0)
Foreign governments	198	(88)	0	(0)	198	(88)
International organizations	10	(4)	6	(2)	4	(2)
Private individuals	119	(0)	116	(0)	3	(0)
Unclassified[b]	29	(0)	0	(0)	29	(0)
Total	1,871	(327)	1,283	(92)	588	(235)

[a]Numbers in parentheses represent libraries. [b]Chiefly because the foreign language barrier (Russian, for example) prevented ready identification of subscriber.

Appendix table 5. Free subscriptions to foreign addresses for *Agricultural Economics Research*, March 1974

Subscriber	Total	Canada	Latin America	Western Europe	Eastern Europe	Africa	Western Asia[a]	Southern Asia[b]	Eastern Asia[c]	Oceania	Undisclosed[d]
					Number						
ERS											
Other USDA (Washington, D.C.)											
Other USDA (field)											
State agricultural statisticians											
Other Federal agencies	85	10				34	7	7	1		26
Congressional offices											
Land grant universitites											
Other universities and colleges	170	6	38	47	22	10	5	13	19	10	
State and local government	21	20								1	
Libraries	16		3	4	3	2	1	1	2		
Farm organizations	3								1	2	
Business and trade organizations	18	2	4	6			1	2	2	1	
Banks	18	1	6			1		6	2	2	
Brokerage houses, management firms											
Media	7			4	1	1		1			
Other private businesses	2	1		1							
Private nonprofit organizations	11		2	4				4	1		
Embassies	3		2	1							
Foreign governments	198	9	41	49	24	17	7	22	17	10	2
International organizations	4			2					1	1	
Private individuals	3		2	1							
Unclassified	29		3	9	11		2	3	1		
Total	588	49	101	128	61	65	23	59	47	27	28

[a]Iran, Iraq, Israel, Jordan, Lebanon, Saudi Arabia, Syria, Turkey. [b]India, Pakistan, Bangladesh, Indonesia, Ceylon. [c]China, Japan, Taiwan, Philippines, Korea, Hong Kong. [d]Usually means only an APO address given.

201-134 O - 76 - 3

POLYSIM: A National Agricultural Policy Simulator

By Daryll E. Ray and Theo F. Moriak

As an aid to providing expanded and more complete information to agricultural policymakers, an agricultural policy simulator (POLYSIM) was developed and used to analyze alternative agricultural policy proposals and economic conditions. This report describes what POLYSIM does and the types of problems for which it is useful.

Keywords: Agricultural policy analysis; Simulation.

INTRODUCTION

Policymakers at all levels need up-to-date, accurate information on available options and their likely impacts to help make decisions. As an aid to national agricultural policymakers, an agricultural policy simulator has been developed and used for analysis of alternative agricultural policy proposals and economic conditions.

The agricultural policy simulator (POLYSIM) was initially developed at Oklahoma State University in 1972. It has since been expanded and refined through cooperative agreements with the Commodity Economics Division, Economic Research Service, U.S. Department of Agriculture. This simulator can provide low-cost, quick, yet extensive analyses of policy proposals.

POLYSIM addresses policy questions as would persons who evaluate policy options. These people include the agriculture committees of the U.S. House of Representatives and the Senate, the executive branch, and others concerned with agricultural policy. Typically, they want to know how a policy change, such as adjustments in target price or loan levels, would affect prices and incomes of individual agricultural sectors as well as net farm income, Government costs, and consumer food prices.

Models exist that can estimate aggregate impact, on net farm income for instance, of pursuing policy stances such as free markets or general cropland retirement programs (*7*). There are also programing models that can estimate least-cost allocation of agricultural resources available to meet expected food needs under various policy environments (*1*, *4*). This first group of models referred to provides valuable intelligence about following a certain general course of action, but in a broad-stroke fashion. The second group gives information similar to POLYSIM, but the models assume perfect knowledge and optimum adjustment. Models of social systems dynamics have been developed for quick and inexpensive analysis of the behavioral response by farmers and consumers to policy changes affecting a given commodity (*5*). However, writers of agricultural policy legislation and administrators of enacted legislation often need quick analysis on how policies will affect livestock producers vis-a-vis crop producers, while allowing for imperfect knowledge and less than optimum response. In the past, no analytical device has been available that would provide such specific and detailed analysis without the prior assumptions of perfect knowledge and optimum adjustment.

DEVELOPMENT OF THE MODEL

The POLYSIM model was constructed differently from most simulation models to attain the desired policy analysis capability. The model makes full use of forecasted data as a reference baseline. Included are the five-year baseline projections of commodity supplies, prices, and use made by ERS. Commodity specialists develop these projections using formal and informal forecasting models tempered with their own experienced judgments. The projections contain explicit assumptions concerning the rates of change in population, per capita incomes, consumer preferences, export demand, technology (including crop yields and livestock gains), and other supply and demand shifters. These projections also assume a specific set of Government farm programs. In most policy analyses, the basic supply and demand shifters remain unchanged. It is the policy related shifts and indirect economic responses through the price mechanism that count in analyzing the impacts of alternative policy proposals. POLYSIM simulates the effects of policy specifications that differ from those assumed in the baseline while holding all other supply and demand shifters the same. The model thus focuses on the interaction of supply and demand responses that result from specified changes in policy variables.

Commodity supply and demand elasticities represent an important part of POLYSIM. The driving forces in the model are the initial and subsequent changes in commodity prices resulting from changes in policy conditions. The magnitude of impact is determined by direct and cross supply and demand elasticities. The elasticities used in the model were developed in stages. Initially, a comprehensive literature review was made to gather past estimates of the required elasticities. Secondly, many of the elasticities were reestimated, using more recent data. Finally, to make the model useful to ERS, commodity specialists reviewed the estimates, which had been categorized by commodity groups. The final revised esti-

mates are used as default values in the model, but users can change any of the elasticities if they have better or more recent information.[1]

OPERATION OF THE MODEL

Commodities included in the model are feed grains, wheat, soybeans, cotton, cattle and calves, hogs, sheep and lambs, chicken, turkeys, eggs, and milk. As indicated earlier, the model is designed to simulate around a set of baseline conditions. Base estimates must be available for all years analyzed in the simulated time frame. To date, most applications have been for a span of 3-5 years.

The user starts a simulation by changing one or more of the policy assumptions used in the base conditions; for example, by using a different series of loan rates. The simulation procedure traces through the effects on production, price, use, and farm income for each of the 11 commodity groups and on agriculture in the aggregate. Elasticities are used to calculate new values for the endogenous variables as deviations away from the base values. To simulate a change in an endogenous variable such as feed grain acreage, the percentage change between simulated and base estimates for the expected price variables is multiplied by direct and cross price elasticities. This operation results in a percentage change in feed grain acreage which is used to obtain a simulated value under the new policy assumptions.

As an example of the types of relationships possible in the model, the expected price, feed grain acreage, and cattle and calf production relationships were set up as follows:

Farmers' expectations of season average prices for feed grains, wheat, soybeans, and cotton were developed as:

Expected crop price (t) = Max [crop price (t-1), loan rate (t)]. These expected prices were used to estimate the movement away from baseline feed grains acreage. The season average feed grain price was linked to annual cattle and calf production as shown below:

Percentage change in	*Elasticity*	*Due to percentage change in*
Feed grain acreage (t)	.10	Expected feed grain price (t)
	-.03	Expected wheat price (t)
	-.06	Expected soybean price (t)
Cattle and calf production (t)	.11	Cattle and calf price (t-1)
	-.02	Hog price (t-1)
	-.01	Sheep and lamb price (t-1)
	-.05	Feed grain price (t-1)

[1] The authors can supply the list of default elasticities.

The percentage change in the left-hand variable is the sum of products of the elasticities and percentage changes in the right-hand variables (from their baseline values). The resulting percentage change in the left-hand variable is multiplied by its base value. Although not included in the example, each quantity equation has a geometrically distributed lag structure to allow multiperiod response to price.

The relationships and response variables used in the model appear in figure 1, which also indicates POLYSIM's complexity. Values for items in rectangles without asterisks are calculated by the model in a fashion similar to the above example while values for items in rectangles with asterisks are introduced exogenously. Many of the exogenous variables are policy instruments; others are included to make the model complete. POLYSIM is recursive in the sense that estimates for variables made during the year simulated may be used as causal variables for succeeding relationships in the same year and in later years.

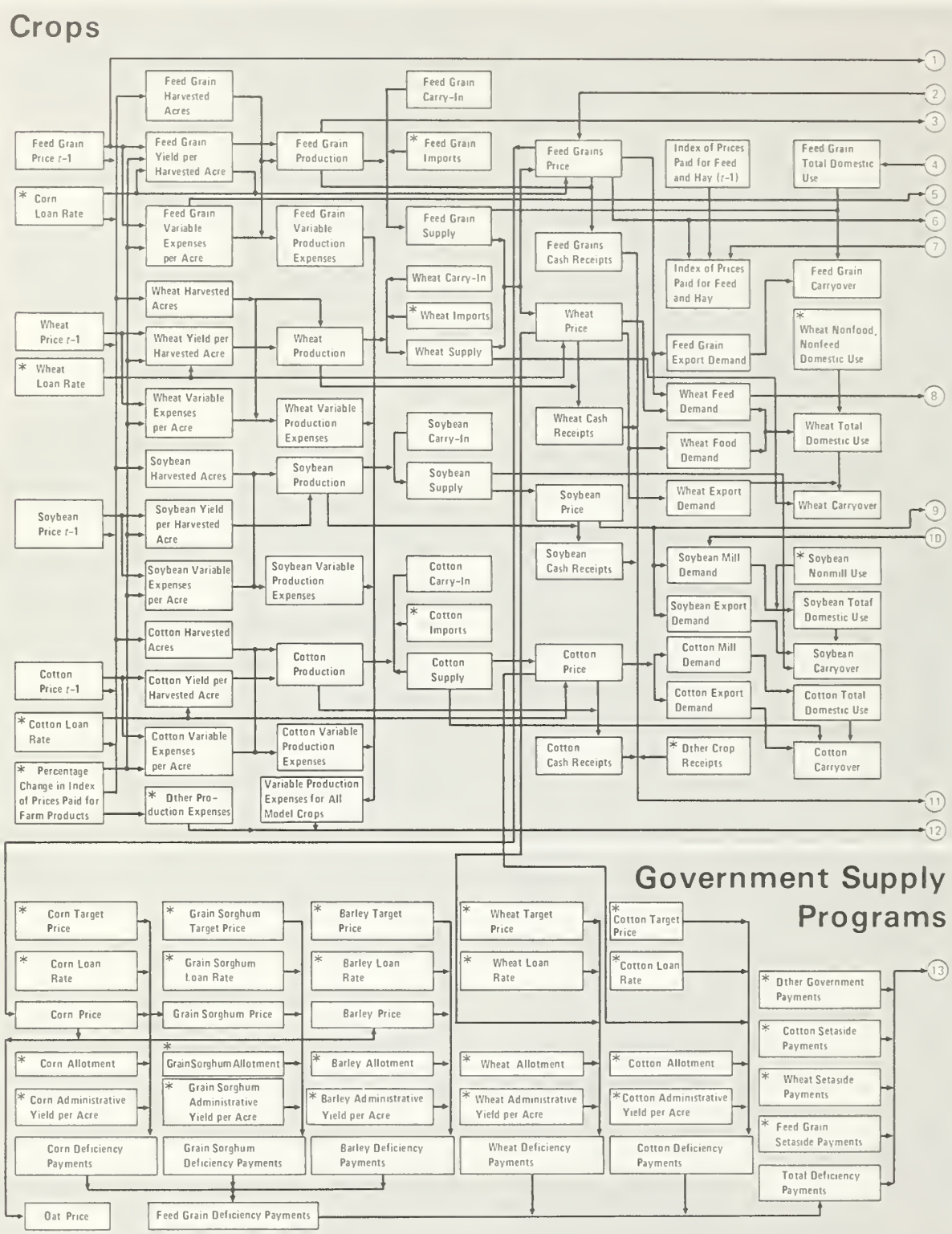
The model provides estimates of acreage, yield, production, variable expenses, total supply, price, commercial domestic demand, exports, carryover, cash receipts, and Government payments for each of the four crops. It also gives estimates of production, market price, and cash receipts for each of the seven livestock categories. Estimates for the various commodity variables are summed and added to exogenous data for commodities not included in the model—to develop aggregate estimates of production expenses, Government payments, gross income, and realized net income.[2]

The flow of the computer program for POLYSIM is diagramed in figure 2. The program uses baseline data which the computer reads and retrieves from disk storage. The program also needs user-supplied information, which includes the number of years to be simulated; the beginning year; farm program options; optional information on policy variable levels, such as target prices, loan rates, and set-aside; and information to be predetermined from outside analysis that differs from the baseline, such as exports, yields, imports, and harvested acres.

The model begins simulating for the first year by calculating livestock production and prices. Production levels are calculated for cattle and calves, hogs, sheep and lambs, chicken, turkeys, eggs, and milk. The production calculations are based on the product's price in the previous year, the percentage difference between the previous year's baseline and the simulated feed grain price, and the differences in prices of competing products times the appropriate direct and cross supply elasticities. The next step is to use this production information and the import and export demand to compute the amounts of livestock products available for domestic consumption. The last step in this part of the model is to

[2] It was assumed that the impact of policy changes on the exogenous commodities was not sufficient to significantly affect the aggregate variables at the national level.

SCHEMATIC DIAGRAM OF POLYSIM



Note. Dots on flow lines indicate lines connect.
Boxes with asterisk contain exogenous variables. Boxes without asterisk contain endogenous variables.

Figure 1

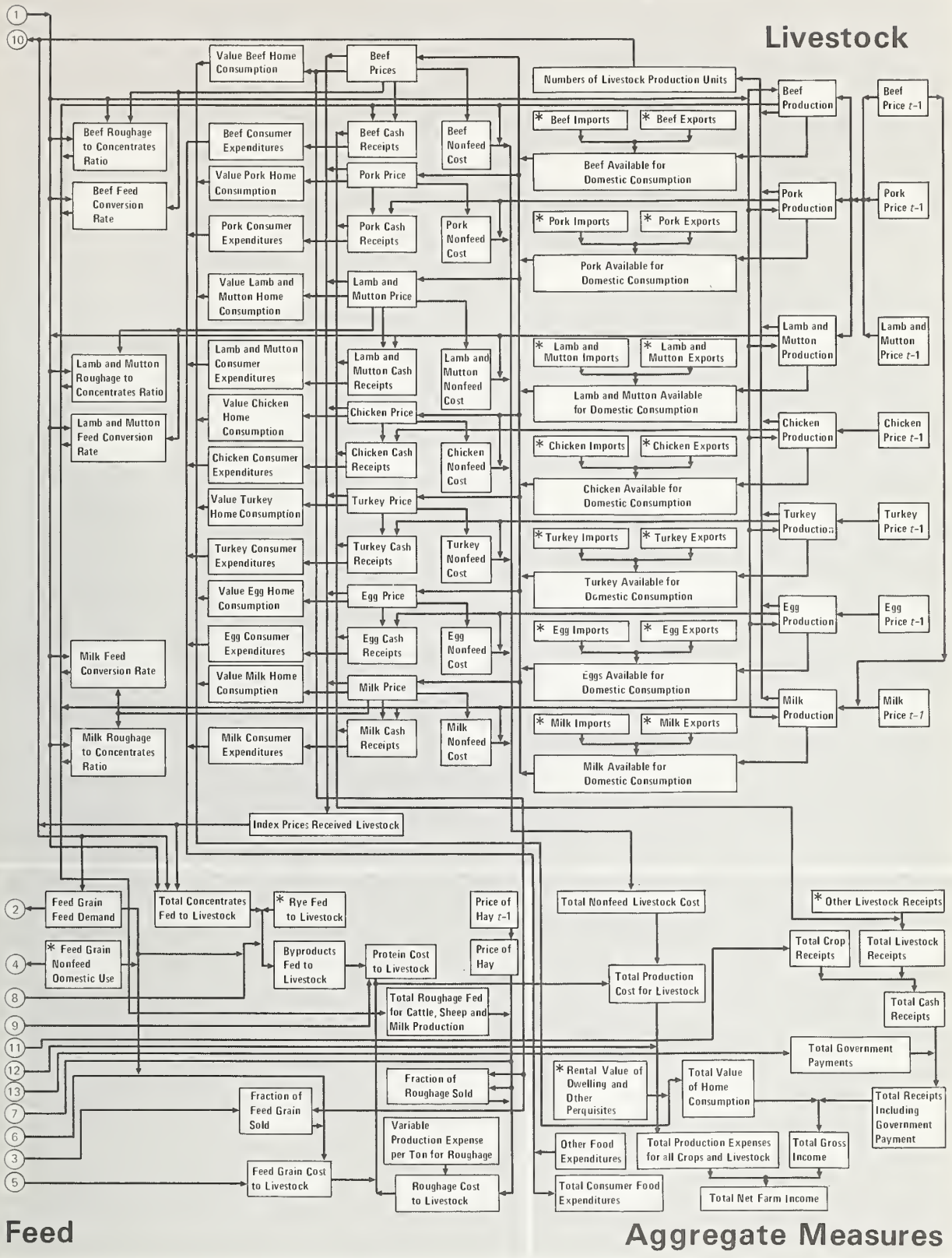
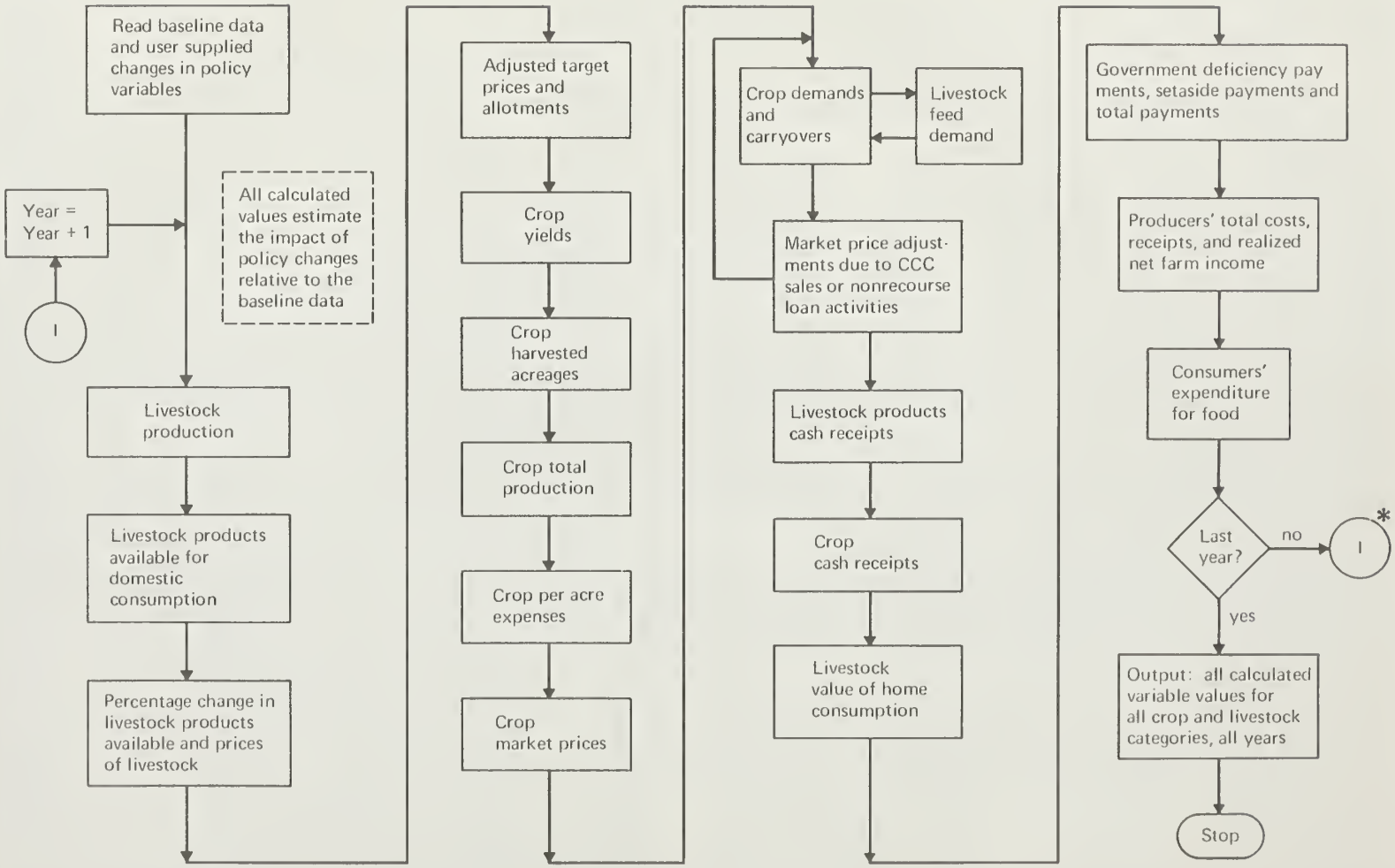


Figure 1—Continued

Flow Chart of Computer Program for POLYSIM



* Note: The computer is instructed to return to the beginning of its program to simulate another year

Figure 2

calculate the percentage change in livestock product availability. By using farm direct and cross price flexibilities, the current year's price for each of the livestock products can be estimated.

As shown in figure 2, use of the seven-block series following the livestock calculations determines crop supplies and production costs for each crop. If the user desires, calculations will determine the adjusted target prices and allotted acreages for feed grains, wheat, and cotton.[3] If the loan rate exceeds the previous year's calculated market price, this rate is used as the expected price in calculating the supply response.

The harvested acreage for each crop is determined as a deviation from the baseline acreage, based on the percentage deviation in last year's market price for the crop from the baseline projections times the appropriate direct and cross elasticities. (See the earlier example in this section.) Yield and per acre production expenses are calculated with a similar equation. The total production for each crop is calculated directly as the product of the yield and harvested acreage. Total expenses equal per acre expenses times the harvested acreages.

The next two blocks in figure 2 represent current crop year price and demand. Crop prices are calculated using price flexibilities and the percentage change in crop supplies. Domestic and export demands depend on the percentage change in prices and the appropriate elasticities. The amount of protein and feed grains demanded for livestock feed is a function of livestock prices, feed prices, and livestock production. The carryover (stocks on hand at end of crop year) are computed as supplies minus demands.

The final six blocks within the model's simulation loop treat producers' costs, receipts, and income. Government payments depend on which farm program the user is simulating. Included are possible support payments based on the assumed target prices, market prices, and loan rates, and set-aside payments calculated as the product of acreage set aside and the rate of Government payment per acre. All such payments are summed to determine total Government payments for the farm program simulated. Aggregate or national estimates are made for total receipts; realized gross income; crop expenses; protein, feed, roughage, and nonfeed costs for livestock; total variable costs; total production costs; and realized net farm income.

OUTPUT, USE, AND LIMITATIONS OF POLYSIM

Figure 3 illustrates the type of information POLYSIM prints out in a summary table. The base values are shown, along with the values resulting from a specific policy or exogenous change in the agricultural outlook. The complete output of POLYSIM is 20 tables of annual estimates for each crop category, including yield; per acre costs; domestic and export demand; ending year stocks; and Government program parameters, such as loan rates, target prices, set-aside acreage, and Commodity Credit Corporation (CCC) acquisitions. Details of livestock production costs and quantities of feed fed are available as well as details on aggregate agricultural variables. A change in policy traces through to all these values; thus, the policymaker receives pertinent information about the effects of the policy change.

POLYSIM can be used to investigate the impact of changes in the following Government variables:

> Target prices and resulting deficiency payments, loan rates, alternative CCC buy-and-sell criteria, allotments, voluntary or mandatory set-aside acreages, per acre payment schedules for voluntary set-aside, program participation rates, and acreage or production quotas.

The effect of yield and export levels different from those in the baseline conditions can also be investigated. The policy, yield, and export levels may be changed from any one crop or combination of the four crops included in the model (feed grains, wheat, soybeans, and cotton). The user traces the effects of these changes through the interrelated crop sectors, the seven livestock sectors, and finally to national aggregates such as realized net farm income.

Operational at Oklahoma State University and in Washington, D.C. in ERS, POLYSIM has been used extensively at both locations. The focus in Washington has been on analysis of current economic issues while the emphasis at Oklahoma State has been on longer range research. Model extensions and modifications and computer input and output revisions continue at both installations.

During 1975, ERS used POLYSIM for several evaluations, including the impact of alternative levels of feed grain availability in the feed and livestock sectors and the effects of various levels of U.S. grain contributions to a world grain reserve. In early 1975, the House and Senate Agriculture Committees were hearing proposals for new agricultural legislation. POLYSIM was run frequently to aid evaluation of effects of the proposals on the crop sector and the general farm economy. A comprehensive analysis was made of the implications on production, prices, and incomes due to alternative energy cost increases and environmental restrictions (*6*). Recent applications at Oklahoma State have centered on evaluations of suggested rules governing stock procurement and release (*2*) and various combinations of target price and loan rate levels (*10*). These extensive simulations with POLYSIM were done at moderate cost since each computer run cost less than $2.

The validity of the model's results hinges on the accuracy of the baseline projections, or reference mode, used by POLYSIM, and the elasticity estimates. Both of these crucial information sets need critical

[3] Soybeans do not have target prices or allotted acres.

Sample Summary Table Printed by POLYSIM

1975 target & loan levels–H.R. 4296, targets adjusted by 1973 act for 1976-79

Item	1975		1976		1977		1978		1979	
	Base	Simulated	Base	Simulated	Base	Simulated	Base	Simulated	Base	Simulated
Harvested acreage										
Feed grains (Mil. acres)	102.60	102.60	103.70	103.70	104.60	104.60	104.90	104.90	106.00	106.11
Wheat (Do.)	67.50	67.50	65.50	65.50	63.70	63.70	61.90	61.90	61.90	61.88
Soybeans (Do.)	55.50	55.50	55.00	55.00	54.00	54.00	54.00	54.00	57.00	56.91
Cotton (Do.)	9.40	9.40	9.50	9.50	9.50	9.50	11.70	11.70	9.90	9.90
Production										
Feed grains (Mil. tons)	216.90	216.90	230.40	230.40	236.00	236.00	240.90	240.90	247.40	248.07
Wheat (Mil. bu.)	2,126.00	2,126.00	2,168.00	2,168.00	2,147.00	2,147.00	2,123.00	2,123.00	2,160.00	2,159.30
Soybeans (Do.)	1,500.00	1,500.00	1,500.00	1,500.00	1,485.00	1,485.00	1,510.00	1,510.00	1,610.00	1,607.39
Cotton (Mil. net bales)	9.80	9.80	9.90	9.90	9.90	9.90	12.00	12.00	10.40	10.40
Cattle (Mil. lbs. carcass)	25,300.00	25,300.00	27,000.00	27,000.00	27,000.00	27,000.00	27,800.00	27,800.00	27,700.00	27,685.03
Pork (Do.)	11,800.00	11,800.00	11,600.00	11,600.00	13,300.00	13,300.00	14,702.00	14,702.00	14,976.00	14,935.52
Sheep (Do.)	420.00	420.00	415.00	410.00	410.00	410.00	406.00	406.00	398.00	397.98
Chickens (Mil. lbs. ready-to-cook)	8,470.00	8,470.00	8,890.00	8,890.00	9,150.00	9,150.00	9,400.00	9,400.00	9,650.00	9,627.05
Turkeys (Do.)	1,840.00	1,840.00	1,950.00	1,950.00	2,020.00	2,020.00	2,080.00	2,080.00	2,150.00	2,145.35
Eggs (Mil. doz.)	5,220.00	5,220.00	5,440.00	5,440.00	5,600.00	5,600.00	5,720.00	5,720.00	5,830.00	5,824.33
Milk (Mil. lbs.)	115,500.00	115,500.00	117,000.00	117,000.00	118,000.00	118,000.00	119,000.00	119,000.00	120,000.00	119,974.00
Prices										
Corn (Dol./bu.)	2.25	2.25	2.00	2.00	1.90	1.90	1.85	1.87	1.90	1.90
Wheat (Do.)	3.15	3.15	2.75	2.75	2.50	2.50	2.50	2.50	2.50	2.50
Soybeans (Do.)	4.00	4.00	3.75	3.75	3.90	3.90	4.40	4.40	5.50	5.52
Cotton (Dol./lb.)	0.39	0.39	0.41	0.41	0.55	0.55	0.45	0.45	0.50	0.50
Cattle (Do.)	0.32	0.32	0.38	0.38	0.45	0.45	0.50	0.50	0.53	0.53
Pork (Do.)	0.41	0.41	0.46	0.46	0.32	0.32	0.32	0.32	0.33	0.33
Sheep (Do.)	0.38	0.38	0.40	0.40	0.42	0.42	0.44	0.44	0.46	0.46
Chickens (Do.)	0.26	0.26	0.23	0.23	0.20	0.20	0.20	0.20	0.21	0.21
Turkeys (Do.)	0.33	0.33	0.29	0.29	0.28	0.28	0.28	0.28	0.29	0.29
Eggs (Dol./doz.)	0.58	0.58	0.53	0.53	0.49	0.49	0.48	0.48	0.48	0.48
Milk (Dol./cwt.)	0.09	0.09	0.09	0.09	0.09	0.09	0.10	0.10	0.10	0.10
Cash receipts (Mil. dol.)	88,289.31	88,289.31	92,518.94	92,518.94	95,773.19	95,773.13	102,431.44	102,540.75	108,930.88	109,181.69
Crops (Do.)	43,539.00	43,538.98	41,775.06	41,775.05	42,014.98	42,014.94	43,156.42	43,265.79	46,539.72	46,595.89
Livestock (Do.)	44,750.36	44,750.36	50,743.92	50,743.92	53,758.23	53,758.23	59,275.02	59,275.02	62,391.18	62,585.81
Total Govt. payments (Mil. dol.)	200.00	523.40	200.00	5,929.19	257.13	7,328.64	200.00	6,395.49	200.00	6,737.70
Feed grains (Do.)	0.0	0.0	0.0	3,809.74	0.0	4,842.55	0.0	3,778.57	0.0	4,035.40
Wheat (Do.)	0.0	0.0	0.0	1,505.12	0.0	2,228.96	0.0	2,020.01	0.0	2,178.35
Cotton (Do.)	0.0	323.40	114.81	529.14	0.0	0.0	47.43	444.34	0.0	323.95
Gross farm income (Do.)	96,929.00	97,252.63	100,918.00	106,648.06	103,314.00	110,386.69	109,845.00	116,151.13	116,430.00	123,222.44
Production expenses (Do.)	77,000.00	76,999.94	83,900.00	83,899.94	87,200.00	87,199.94	93,030.00	93,109.31	98,730.00	98,774.19
Net farm income (Do.)	19,929.00	20,252.69	17,018.00	22,748.13	16,114.00	23,186.75	16,816.00	23,041.81	17,700.00	24,448.25

Figure 3

evaluation and updating continually to ensure that POLYSIM draws on the best information available at each point in time.

POLYSIM is not a tool for all problems. As a positivistic model, it cannot estimate optimum resource allocations for specific demand levels or productive capacity subject to resource constraints. Analyses of international stock reserve schemes are hindered because the world grain market is exogenous to the system. As with econometric projection models, users must anticipate and build in structural changes in supply and demand parameters. The model does not provide estimates of changes in the organizational makeup of agriculture, in land values, or in liability and asset variables found in national balance sheets of agriculture. However, output from the model, such as net farm income under various farm policy structures, could be inputed into other analytical models designed to make these estimates. Price variations during the year cannot be analyzed because the prices in POLYSIM are season averages for crops and calendar year averages for livestock. Also, the model cannot extend the baseline, but it may be useful in revising an existing baseline if the impacts are due only to variables in POLYSIM. Policies can be analyzed only over the period for which annual baseline projections are available.

However, as detailed earlier, POLYSIM does have considerable value for expanding the information agricultural policymakers need, either on its own or through linkage with other models.

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Estimating Land Use Patterns: A Separable Programing Approach

By Wen-yuan Huang and Howard C. Hogg

A model is described that projects land use patterns under both competitive and profit maximizing conditions. Separable programing is utilized to internalize price effects resulting from project production, and to allow extension of the basic model to include cross-elasticities. An empirical example, as used to illustrate the model, includes a detailed description of model formulation for solution on the IBM-MPS System.

Keywords: Separable programing, Project evaluation, Competitive-equilibrium land use, Profit-maximizing land use.

INTRODUCTION

The model described in this article can be used to predict land use patterns on newly developed projects when project production is expected to affect product price. Market demand and supply curves summarizing preproject conditions are included in the model for each market available to producers and each commodity that can be grown on the project. A linear programing analysis is used to predict land use patterns for the project. Project supplies are added to those of existing producers to assess demand and price implications. The project can be modeled as if it were a profit-maximizing monopoly, or, if appropriate, as if there were competitive equilibrium for each commodity, site, and market. A unique feature involves a method for approximating the competitive solution using ordinary linear programing. The model incorporates a constraint defining the marginal cost of commodities produced in the project, and it modifies the criterion function to compare average revenue with marginal cost. The model, as formulated, can be solved with the IBM-MPS (Mathematical Programing System).

There are a number of possible applications of the model. Land use patterns under competitive conditions, and, consequently, the direct effects of newly developed projects can be estimated. When production control is to be exercised by the developing entity, profit-maximizing land use patterns can also be estimated. This class of project exists when a private investor, producer cooperative, or Government agency desires to maximize project returns. The model presents an alternative to the point demand-minimum cost models widely used in interregional planning. In an application of this type, the model is formulated with demand curves for each crop and market but no explicit supply curves. The solution indicates the least-cost production pattern, by region and land class, to meet the specified demands. The main difference between the two approaches is that in the model discussed here, equilibrium product prices and quantities demanded are determined by both supply and demand.

MATHEMATICAL MODEL

The basic structure of the land use model can be expressed as follows:

Maximize:

$$Z = \sum_i \sum_j \sum_k (P_{ik}\Theta_{ij}X_{ijk} - C_{ijk}X_{ijk}) \quad (1)$$

Subject to:

$$\sum_i \sum_k X_{ijk} \leqslant L_j \text{ for } j=1, \ldots, J \quad (2)$$

$$Q_{ik} = A_{ik} + B_{ik}P_{ik} \text{ for } i=1, \ldots, I \quad k=1, \ldots, K \quad (3)$$

$$Q_{ik} = \Theta_{ij}X_{ijk}, \quad (4)$$

$$P_{ik} \geqslant 0, \text{ and}$$

$$X_{ijk} \geqslant 0 \text{ for } i=1, \ldots, I \quad j=1, \ldots, J \quad k=1, \ldots, K$$

Where:

- P_{ik} = Market price per unit of the ith crop in the kth market
- Θ_{ij} = Yield/acre of the ith crop on the jth land class
- X_{ijk} = Acreage of the ith crop planted on the jth land class and subsequently sold in the kth market
- C_{ijk} = Cost of production per acre of the ith crop on the jth land class and of transportation of the per acre product to the kth market
- L_j = Total available acreage of the jth land class
- Q_{ik} = Net market demand for the ith crop in the kth market to be supplied by the new project; that is:

$$P_{ik} = a_{ik} + b_{ik}q_{ik}^{d} \quad (5)$$

and the current supply curve of the ith crop at the kth market is:

$$P_{ik} = c_{ik} + d_{ik} q^{s}_{ik} \quad (6)$$

Then:

$$Q_{ik} = q^{d}_{ik} - q^{s}_{ik} \text{ or } Q_{ik} = A_{ik} + B_{ik} P_{ik} \quad (7)$$

Where:

A_{ik} = The constant of the net demand curve

$$A_{ik} = \left[\frac{-a_{ik}}{b_{ik}} + \frac{c_{ik}}{d_{ik}} \right] \quad (8)$$

B_{ik} = The price coefficient of the net demand curve

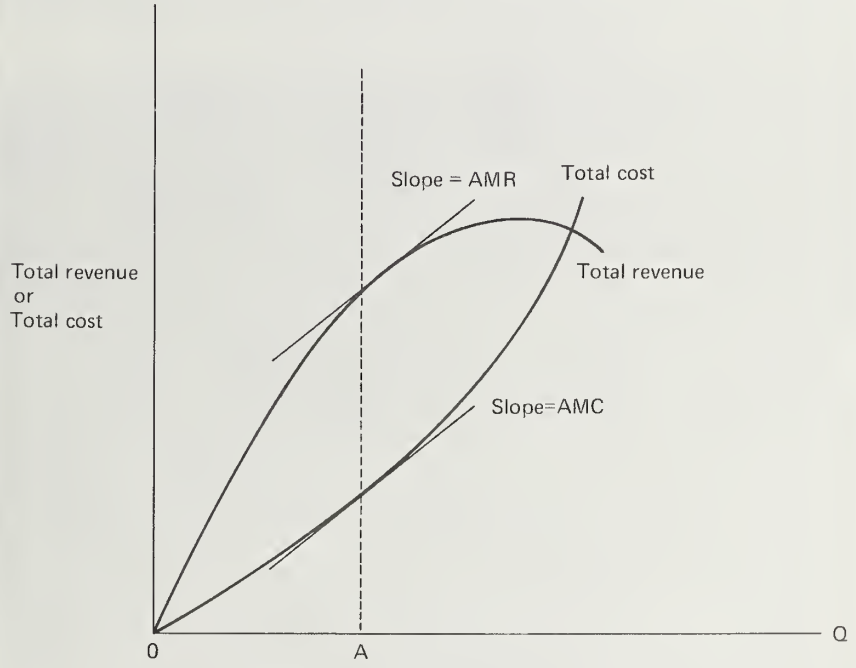
$$B_{ik} = \left[\frac{1}{b_{ik}} - \frac{1}{d_{ik}} \right] \quad (9)$$

The model consists of sets of linear constraints and a quadratic objective function. That is, Z is a function of P_{ik} and X_{ijk}. For maximizing or minimizing a quadratic objective function subject to linear constraints, various solution procedures have been developed by Kuhn and Tucker (*7*), Beale (*1*, *2*), Wolfe (*12*), Houthakker (*6*), and Hadley (*3*). A review of interregional quadratic formulations using some of these solution procedures is available from Heady and Hall (*4*).

A land use pattern under "monopoly" conditions can be estimated by maximizing the objective function (1) (assuming a concave function) subject to the constraint sets (2), (3), and (4). When land is limited, the solution will fall on the line OA shown in figure 1. When land is relatively abundant, the solution is point A. At this point, aggregate marginal revenue is equal to aggregate marginal cost.

By setting price constraints, the model can be used to estimate the land use pattern under competitive equilibrium conditions. Such a condition is reached when the last piece of land entering production will give the same marginal rent for any crop planted. Under the assumption of a concave objective function, additional constraints are required to solve the model under two different land availabilities. In the first case, quantities of each crop demanded by each market can always be provided

Optimal Solution for Land Use Under Monopoly Conditions (MR=MC)



Aggregated quantity of production

Note: Point A is where aggregated marginal revenue (AMR) equals aggregated marginal cost (AMC).

Figure 1

because land is not a limiting factor. The last piece of land entering production earns no rent for any crop planted. The constraints to be added are:

$$P_{ik} = U_{ik}^{(1)} \cdot W_{ik}^{(1)} + U_{ik}^{(2)} \cdot W_{ik}^{(2)} + \ldots + U_{ik}^{(L)} \cdot W_{ik}^{(L)} \quad (10)$$

$$= \sum_{j=1}^{L} U_{ik}^{(j)} \cdot W_{ik}^{(j)} \text{ for } i=1, \ldots, I$$

$$k=1, \ldots, K$$

Where:

$U_{ik}^{(j)} = \frac{C_{ijk}}{\Theta_{ij}}$, the marginal cost with $U_{ik}^{(j)} < U_{ik}^{(j+1)}$

for $j=1, \ldots, L-1$, and

$W_{ik}^{(j)}$ for $j=1, \ldots L$ constituting logical variables.

Each logical variable will take a value of 0 to 1 and

$$\sum_{j=1}^{L} W_{ik}^{(j)} = 1.$$

Figure 2 shows the prices P_{ik} (in the solution) will be between $U_{ik}^{(1)}$ and $U_{ik}^{(m)}$, depending on the position of the demand curve Q_{ik}. The solution is obtained at the point where the demand curve intersects the marginal cost curve MC_{ik}. This marginal cost is the cost of producing a unit of the ith crop on the last unit of land entering production and of selling it in the kth market.

In the second case, land is limited and all of it is brought into production. The last piece of land entering production will earn the same marginal rent for any crop planted. Figure 3 shows that price P_{ik} will be greater than or equal $U_{ik}^{(m)}$. The constraints needed are:

$$P_{ik} - \sum_{L=1}^{m} U_{ik}^{(L)} W_{ik}^{(L)} = R \text{ for } i=1, \ldots, I \quad (11)$$

$$k=1, \ldots, K$$

Where:

R = Marginal net price, an internally determined constant

Note that by setting $R = 0$ in constraint (11), the constraint (10) becomes a special case of (11). An equilibrium solution is reached only when the minimum marginal rent is obtained, but all land is brought into production. Given the form of the objective function (1), it is likely that many values of R will satisfy relationship (11). However, only one value of R is a minimum for all possible R's and provides an equilibrium solution.[1] Here, R must be added to the objective function:

$$Z = \sum_{i} \sum_{j} \sum_{k} P_{ik} \Theta_{jk} \cdot X_{ijk} - C_{ijk} X_{ijk} - \alpha R \quad (12)$$

Where:

α = is an arbitrarily large nonnegative value, and $R \geqslant 0$

A solution under competitive conditions can thus be obtained by maximizing the objective function (12) subject to the constraint sets (2), (3), (4), and (11). This solution represents an equilibrium in the crop sector and in allocating products from new production areas to various markets. The solution is not the equivalent of Samuelson's equilibrium trade solution, which provides a longrun trade equilibrium (*10*). The competitive solution of our land use model can be interrupted as a longrun equilibrium because R is the opportunity cost of retaining land in a particular use. When a trade equilibrium is desired, the model can be extended to provide it.[2]

SEPARABLE PROGRAMING FORMULATION

In this article, the solution procedure of separable programing, described by Hadley, is used (*3*). Separable programing is a technique for handling a nonlinear objective function or nonlinear constraints that can be written as:

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[1] As a simple example of the equilibrium solution, assume one market for two crops. If at an arbitrary production level, marginal rent R_{11} from crop 1 is greater than marginal rent R_{21} from crop 2, the land used by crop 2 will be reallocated to crop 1. Consequently, R_{11} will decrease, while R_{21} will increase because of the downward-sloping net demand curves for the two crops. Land reallocation will continue until an equilibrium condition, R_{11} equals R_{21}, is reached. In other words, marginal rent from planting either crop 1 or crop 2 is the same.

The term $-\alpha P$, wherein α is a positive constant and R is rent, is to be maximized. The smallest value of R which makes R_{11} equal R_{21} equal R will be found. Thus, by employing the constraints (equation (11)) and the objective function (equation (12)), equilibrium in the crop sector can be obtained.

[2] In his net social payoff model, Samuelson assumes that the markets are interdependent; trade between two markets is allowed. (The model presented here assumes no trade between markets.) The equilibrium solution is obtained when the price difference of a commodity between any two markets is less than the transportation cost of moving a unit of commodity from one market to the other. When this condition is reached, net social payoff is maximized. Takayama and Judge (*1*) and Plessner and Heady (*9*) formulated constraints for an equilibrium in trade as:

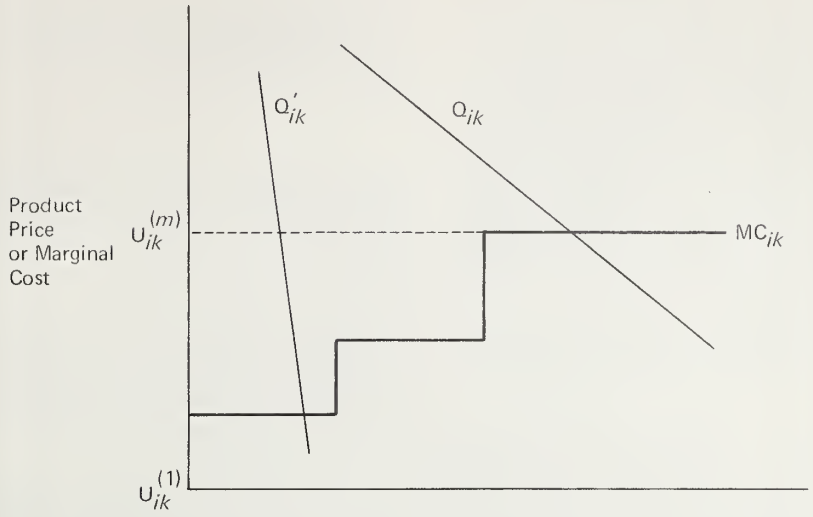
$$P_{ik} - P_{ih} \leq T_{kh} \text{ for all } i, k, \text{ and } h$$

Where:

T_{kh} is the transportation cost between k and h markets

This set of constraints can be added to our model so that an equilibrium solution in both the crop sector and trade can be achieved.

Equilibrium Solution (P_{ik} - MC_{ik}) with Abundant Land



Note: Q_{ik} and Q'_{ik} are two possible positions of demand curve for ith crop on kth market.

Figure 2

Equilibrium Solution (P_{ik} = MC_{ik} = constant) with Limited Land

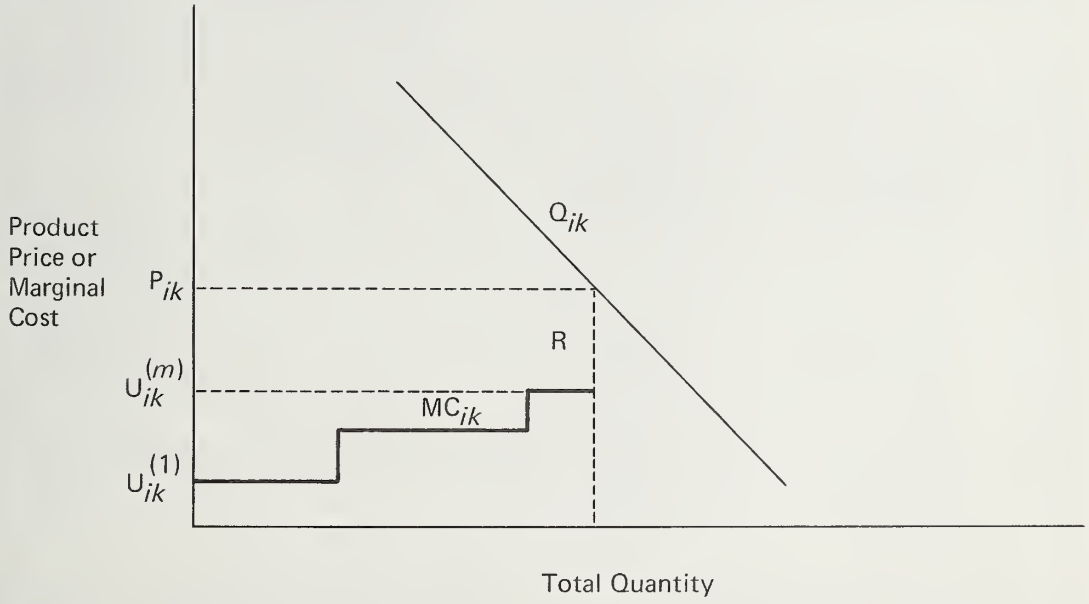


Figure 3

$$f(X_1, X_2, \ldots, Xn) = f_1(X_1) + \ldots f_n(X_n).$$

In each nonlinear function $f_i(X_i)$, $i=1, \ldots, n$ is a function of only one variable and it is approximated by a piecewise linear function. The nonlinear problem thus becomes a linear programing problem. One reason for using separable programing is because the procedure has been incorporated into the IBM-MPS (8). MPS, one of the most flexible computer packages available, provides great efficiency in computation. Another reason for using separable programing is because of the nature of the model. The quadratic terms in the objective function can be expressed as a linear combination of a function of only one variable. Thus, the function Z equals $f(P_{ik}, X_{ijk})$ can be expressed as Z equals $f_1(P_{ik})$ plus $f_2(X_{ijk})$ as follows:

1. Rearrange the nonlinear terms in the objective function:

   $$\sum_i \sum_j \sum_k P_{ik} \Theta_{ij} X_{ijk}$$

   as

   $$\sum_i \sum_k P_{ik} \left(\sum_j \Theta_{ij} X_{ijk}\right)$$

2. Since $\sum_j \Theta_{ij} X_{ijk}$ is equal to Q_{ik}, it is valid to substitute $(A_{ik} + B_{ik}P_{ik})$ for $\sum_j \Theta_{ij} X_{ijk}$ in the objective function. The objective function (12) becomes:

   $$Z = \sum_i \sum_k P_{ik} \cdot A_{ik} + \sum_i \sum_k B_{ik} P_{ik}^2 - \sum_i \sum_j \sum_k C_{ijk} \cdot \quad (13)$$

   $$X_{ijk} - \propto R$$

Because the original objective function (1) is a separable function and can be expressed as function (13), separable programing can be employed to search for the optimum solution. Furthermore, with objective function (13), the quadratic term $\sum_i \sum_k B_{ik} P^2_{ik}$ can be expressed in the matrix form $P'BP$ as:

$$\begin{bmatrix} P_{11} P_{12} \ldots P_{ik} \ldots P_{IK} \end{bmatrix} \begin{bmatrix} B_{11} & & & & \\ & B_{12} & & & \\ & & \ldots & & \\ & & & B_{ik} & \\ & & & & \ldots \\ & & & & B_{IK} \end{bmatrix} \begin{bmatrix} P_{11} \\ P_{12} \\ \ldots \\ P_{ik} \\ \ldots \\ P_{IK} \end{bmatrix}$$

The matrix B is a diagonal one. If all values of B_{ik} for $i=1, \ldots, I, K=1, \ldots, K$ are negative, the matrix B is negative definite and function (13) is concave. In this case, a unique solution exists for maximization.

To test to determine if a solution is possible, three steps must be taken before preparing the computer input data. These are: (1) linearization of the nonlinear term; (2) approximation of the logical constraint (11): and (3) construction of an MPS data matrix. The second step is needed only for a competitive equilibrium problem.

LINEARIZATION OF NONLINEAR TERMS

Before constructing the constraint matrix, the nonlinear term $\sum_i \sum_k B_{ik} P^2_{ik}$ must be linearized. Procedures for linearization are given in (8). However, an example of linearization, for the term $B_{11}P^2_{11}$ ($i=1, k=1$) appears below. Two equations are needed for each nonlinear term: the grid equation, and the functional equation.

The grid equation is:

$$P_{11} = X_{11}^{(0)} + D_{11}^{(1)} X_{11}^{(1)} + D_{11}^{(2)} X_{11}^{(2)} + \ldots + D_{11}^{(n_{11})} X_{11}^{(n_{11})} \quad (14)$$

Where:

$X_{11}^{(0)}$ = The value of P_{11} at the beginning of the first interval

$X_{11}^{(r)}$ for $r=1, \ldots n$ are special variables for separable variable P_{11}

$0 \leqslant X_{11}^{(r)} \leqslant 1$, and if $X_{11}^{(1)} \ldots X_{11}^{(r)}$ are used to compute the P_{11} value, then

$$X_{11}^{(1)} = X_{11}^{(2)} = \ldots = X_{11}^{(r-1)} = 1 \text{ and } X_{11}^{(r+1)} = X_{11}^{(r+2)} = X_{11}^{(n_{11})} = 0$$

$D_{11}^{(r)}$ = length of the rth interval, $r = 1, \ldots, n_{11}$

The values of $D_{11}^{(r)}$ have to be determined by the user and are used for linearization.[3]

[3] $D_{11}^{(L)}$ is an arbitrarily small increment of the price P_{11}. The magnitude of $D_{11}^{(r)}$ should be small if the value of the nonlinear term $B_{11}P^2_{11}$ is to be sensitive to the change in price P_{11}.

The functional equation is:

$$B_{11}P_{11}^2 = Y_{11}^{(0)} + E_{11}^{(1)} X_{11}^{(1)} + \ldots + E_{11}^{(n_{11})} X_{11}^{(n_{11})} \quad (15)$$

Where:

$Y_{11}^{(0)}$ = is the value of $B_{11}P_{11}^2$ at the beginning of the first interval

$E_{11}^{(r)}$ = is the change in the value of $B_{11}P_{11}^2$ in the rth interval for $r=1, \ldots, n_{11}$

Figure 4 illustrates the linearization process and the relationship between the two functions. For example, the value of $B_{11}P_{11}^2$ at the point (X, Y) is $\left(B_{11}E_{11}^{(1)} + B_{11}E_{11}^{(2)}\right)$, and the corresponding value for P_{11} is $\left(D_{11}^{(1)} + D_{11}^{(2)}\right)$. To obtain these values from equations (14) and (15), the special variables $X_{11}^{(1)}$ and $X_{11}^{(2)}$ are set equal to 1 and the other values of $X_{11}^{(r)}$ are set equal to 0.

Similar procedures can be employed for linearizing each of the other terms, $B_{ik}P_{ik}^2$ for all i not equal to 1 and k not equal to 1. Once the linearization procedures are completed, the constraint matrix can be constructed.

APPROXIMATION OF THE LOGICAL CONSTRAINT FOR THE COMPETITIVE EQUILIBRIUM CONDITION

Employing the special variables described earlier, the constraint (11) can be reformulated as:

$$P_{ik} - M_{ik}^{(1)} X_{ik}^{(1)} - M_{ik}^{(2)} X_{ik}^{(2)} - \ldots - M_{ik}^{(n)} X_{ik}^{(n)} = R$$

for $i=1, \ldots, I$
$k=1, \ldots, K$ (16)

Where:

$$M_{ik}^{(1)} = U_{ik}^{(1)}$$

$$M_{ik}^{(2)} = U_{ik}^{(2)} - U_{ik}^{(1)}$$

$$\vdots$$

$$M_{ik}^{(n)} = U_{ik}^{(n)} - U_{ik}^{(n-1)}$$

$X_{ik}^{(r)}$ = The special variables defined in equation (14), $r=1, n$. Constraint (16) is an approximation of constraint (11). The approximation error will be small if the magnitudes of $M_{ik}^{(2)}, M_{ik}^{(3)}, \ldots M_{ik}^{(n)}$ are small.

CONSTRAINT MATRIX

The objective function (13) and the constraint sets (2), (3), (4) and (16) for three crops (I=3), two land classes (J=3) and two markets (J=2) are constructed in matrix form in table 1. Each row is a constraint and each column, a structural variable. The matrix, which represents the basic structure of the model, can be extended for a relatively large number of crops, land classes, and markets. Additional constraints may be added for other types of resources. Because P_{ik} and X_{ijk} are shown as structural variables, cross-elasticities between crops can be built into the model by restating the relationship between P_{ik} and X_{ijk} (see appendix).

USE OF THE MODEL

In 1968, a paper published in this journal described an iterative model similar to the one developed here (*5*). The illustrative example comes from that article. Tables 3 and 4 contain all of the basic data which, except for the net demand curves in table 3, are identical to the data required in the earlier formulation. Both models are project oriented but ours is more general because cross-elasticities and constraints other than land and commodity demand can be accommodated. Table 2 illustrates how the input data is entered into the matrix shown in general form in table 1. In table 2, the coefficients A_{ik} and B_{ik} are from table 3, and C_{ijk} and Θ_{ij} are from table 4 (the value for $\propto$ is 1,000,000). The coefficients Δ's and M's are computed by using equation 15 and these are as follows:

Δ_1 = 843325	Δ_{17} = 50150	M_1 = 140
Δ_2 = 371063	Δ_{18} = 150450	M_2 = 4.444
Δ_3 = 438529	Δ_{19} = 250750	M_3 = 5.556
Δ_4 = 505995	Δ_{20} = 351050	M_4 = 88.888
Δ_5 = 573461	Δ_{21} = 33025	M_5 = 1.112
Δ_6 = 640927	Δ_{22} = 99075	M_6 = .909
Δ_7 = 708393	Δ_{23} = 165125	M_7 = 175
Δ_8 = 775859	Δ_{24} = 231175	M_8 = 41.666
Δ_9 = 843325	Δ_{25} = 83825	M_9 = 83.34
Δ_{10} = 910791	Δ_{26} = 251475	M_{10} = 100
Δ_{11} = 978257	Δ_{27} = 422875	M_{11} = 5.55
Δ_{12} = 1045723	Δ_{28} = 592025	M_{12} = 6.945
Δ_{13} = 1113189	Δ_{29} = 85825	M_{13} = 110.53
Δ_{14} = 1180655	Δ_{30} = 257475	M_{14} = .5850
Δ_{15} = 1248121	Δ_{31} = 499125	M_{15} = .6530
Δ_{16} = 1315587	Δ_{32} = 600775	

The formulations represent two alternatives: (1) the land use pattern expected on a newly developed project under competitive conditions, and (2) the profit-

maximizing land use pattern when production control, as opposed to free choice, is exercised. Tables 5 and 6 compare the original solution with that of the present model. The example uses five crops, three land classes, and one market.

All lands in the project enter production under competitive conditions in the example. In the "monopoly" solution, only land class 2 is utilized in its entirety, resulting in a zero opportunity rent for land. The "monopoly" prices are, of course, higher than those indicated for the competitive solution. The material presented in tables 5 and 6 is available directly from model output. In addition, certain other impacts of the project can be quantified from the model. For example, the quantities grown by project producers can be obtained by solving the original supply curves with the computed equilibrium prices. Performing the same operation on the demand curves results in an estimate of total market supply. The difference between solution values for the iterative and separable procedures results from the linearization of equation (7) and the approximation of equation (11) by (16). Objective function values for the competitive solution were $307,481 (separable) and $310,183 (iterative). A value of $1,052,032 was obtained for the monopoly solution.

Some users may be concerned that the budgeted production costs are based on factor use under a price level different from the final equilibrium prices. This inconsistency can be resolved by rebudgeting at the new prices. If optimum input combinations change, the model can be rerun with the newly budgeted costs. Several attempts at this iterative process will isolate a price range that brackets the equilibrium position. An acceptable range depends on the linearization precision, data accuracy, and the relative magnitude of the range of prices. In most applications, it should not be necessary to undertake this step as the difference between the budget price and final equilibrium price will be small.

Linearization of the Nonlinear Function $B_{11}P^2_{11}$

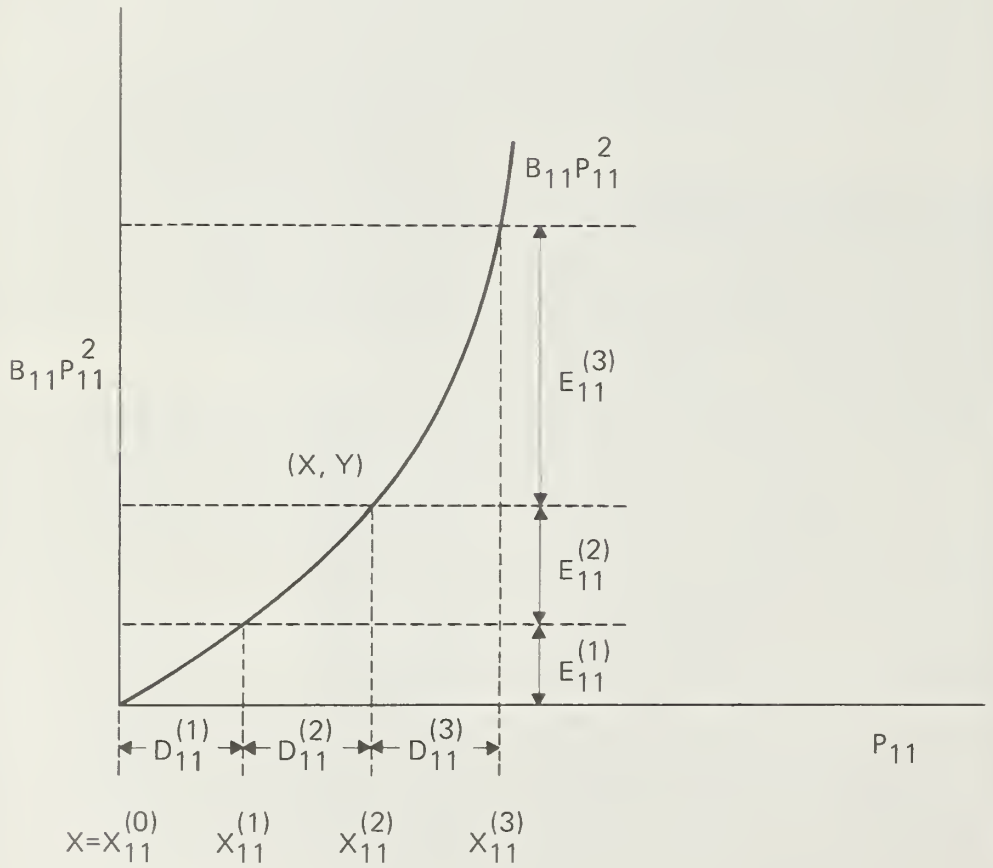


Figure 4

Table 1. Data matrix for land use model

ACTIVITY LEVEL

ROW \ COLUMN	P^2_{11}	P^2_{21}	P^2_{31}	P^2_{12}	P^2_{22}	P^2_{32}	P_{11}	P_{21}	P_{31}	P_{12}	P_{22}	P_{32}	X_{111}	X_{211}	X_{311}	X_{121}	X_{221}	X_{321}	X_{112}	X_{212}	X_{312}	X_{122}	X_{222}	X_{322}	R
Z	B_{11}	B_{21}	B_{31}	B_{12}	B_{22}	B_{32}	A_{11}	A_{21}	A_{31}	A_{12}	A_{22}	A_{32}	$-C_{111}$	$-C_{211}$	$-C_{311}$	$-C_{121}$	$-C_{221}$	$-C_{321}$	$-C_{112}$	$-C_{212}$	$-C_{312}$	$-C_{122}$	$-C_{222}$	$-C_{322}$	
L1													1	1	1				1	1	1				
L2																1	1	1				1	1	1	
D11							$-B_{11}$						$(-)_{11}$			$(-)_{12}$									
D21								$-B_{21}$						$(-)_{21}$			$(-)_{22}$								
D31									$-B_{31}$						$(-)_{31}$			$(-)_{32}$							
D12										$-B_{12}$									$(-)_{11}$			$(-)_{12}$			
D22											$-B_{22}$									$(-)_{21}$			$(-)_{22}$		
D32												$-B_{32}$									$(-)_{31}$			$(-)_{32}$	
N11	-1																								
N21		-1																							
N31			-1																						
N12				-1																					
N22					-1																				
N32						-1																			
G11							-1																		
G21								-1																	
G31									-1																
G12										-1															
G22											-1														
G32												-1													
P11							-1																		1
P21								-1																	1
P31									-1																1
P12										-1															1
P22											-1														1
P32												-1													1
Upper Bound																									
Lower Bound																									

SPECIAL VARIABLES

ROW \ COLUMN	X^1_{11}	X^2_{11}	X^3_{11}	X^4_{11}	X^1_{21}	X^2_{21}	X^3_{21}	X^4_{21}	X^1_{31}	X^2_{31}	X^3_{31}	X^4_{31}	X^1_{12}	X^2_{12}	X^3_{12}	X^4_{12}	X^1_{22}	X^2_{22}	X^3_{22}	X^4_{22}	X^1_{32}	X^2_{32}	X^3_{32}	X^4_{32}
Z																								
L1																								
L2																								
D11																								
D21																								
D31																								
D12																								
D22																								
D32																								
N11	Δ_{111}	Δ_{112}	Δ_{113}	Δ_{114}																				
N21					Δ_{211}	Δ_{212}	Δ_{213}	Δ_{214}																
N31									Δ_{311}	Δ_{312}	Δ_{313}	Δ_{314}												
N12													Δ_{121}	Δ_{122}	Δ_{123}	Δ_{124}								
N22																	Δ_{221}	Δ_{222}	Δ_{223}	Δ_{224}				
N32																					Δ_{321}	Δ_{322}	Δ_{323}	Δ_{324}
G11	d_{111}	d_{112}	d_{113}	d_{114}																				
G21					d_{211}	d_{212}	d_{213}	d_{214}																
G31									d_{311}	d_{312}	d_{313}	d_{314}												
G12													d_{121}	d_{122}	d_{123}	d_{124}								
G22																	d_{221}	d_{222}	d_{223}	d_{224}				
G32																					d_{321}	d_{322}	d_{323}	d_{324}
P11																								
P21																								
P31																								
P12																								
P22																								
P32																								
Upper Bound	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lower Bound	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ROW \ COLUMN	Y^1_{11}	Y^2_{11}	Y^3_{11}	Y^1_{21}	Y^2_{21}	Y^3_{21}	Y^1_{31}	Y^2_{31}	Y^3_{31}	Y^1_{12}	Y^2_{12}	Y^3_{12}	Y^1_{22}	Y^2_{22}	Y^3_{22}	Y^1_{32}	Y^2_{32}	Y^3_{32}	RHS	
Z																			N	∞
L1																			L	L_1
L2																			L	L_2
D11																			E	A_{11}
D21																			E	A_{21}
D31																			E	A_{31}
D12																			E	A_{12}
D22																			E	A_{22}
D32																			E	A_{32}
N11																			E	Y^o_{11}
N21																			E	Y^o_{21}
N31																			E	Y^o_{31}
N12																			E	Y^o_{12}
N22																			E	Y^o_{22}
N32																			E	Y^o_{32}
G11																			E	x^o_{11}
G21																			E	x^o_{21}
G31																			E	x^o_{31}
G12																			E	x^o_{12}
G22																			E	x^o_{22}
G32																			E	x^o_{32}
P11	M_{111}	M_{112}	M_{113}																E	0
P21				M_{211}	M_{212}	M_{213}													E	0
P31							M_{311}	M_{312}	M_{313}										E	0
P12										M_{121}	M_{122}	M_{123}							E	0
P22													M_{221}	M_{222}	M_{223}				E	0
P32																M_{321}	M_{322}	M_{323}	E	0
Upper Bound	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Lower Bound	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

NOTE. i = Crop, j = Land class, k = Market

$M_{ikr} = M^{(r)}_{ik}$ in equation (16)

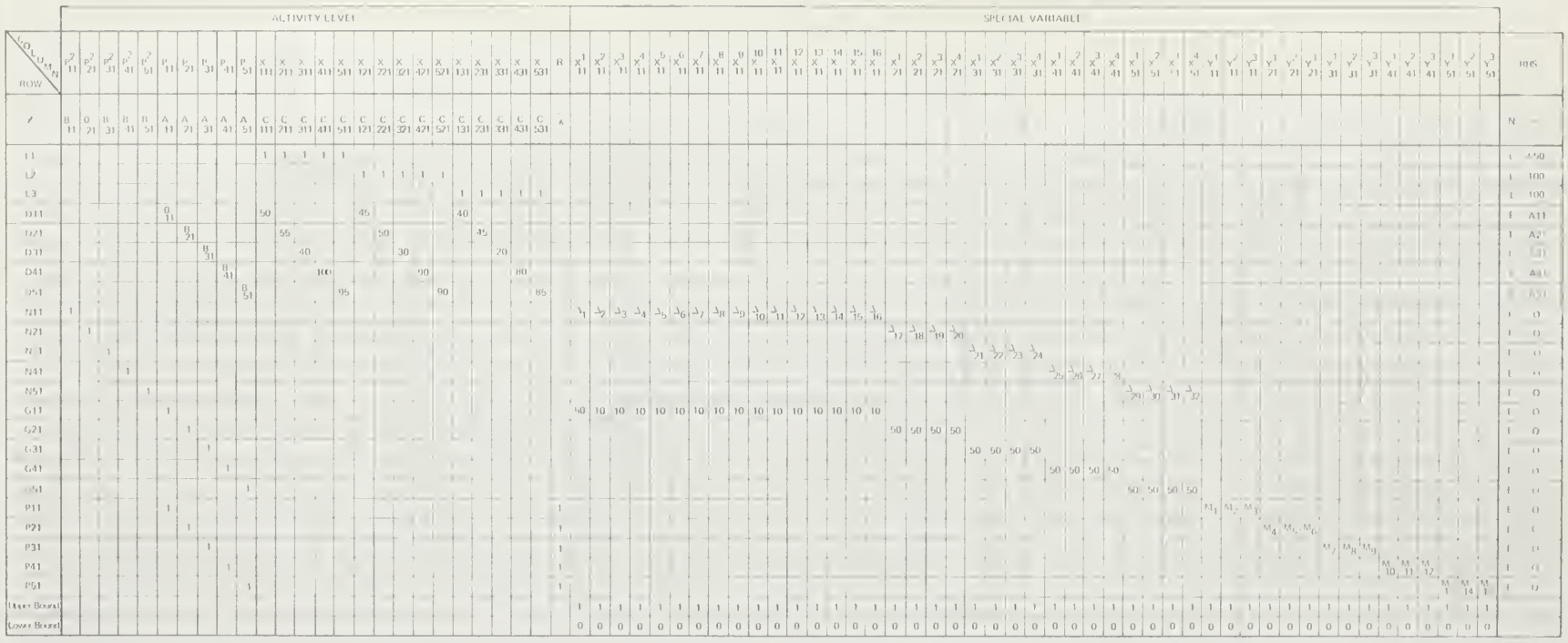
$\Delta_{ikr} = E^{(r)}_{ik}$ in equation (15)

$d_{ikr} = D^{(r)}_{ik}$ in equation (14)

$X^r_{ik} = X^{(r)}_{ik}$ in equation (14)

$Y^r_{ik} = X^{(r)}_{ik}$ in equation (16)

Table 2. Data matrix for land use model



Note A_{11} 7883, A_{21} 4039, A_{31} 4184, A_{41} 7583, A_{51} 7500,
B_{11} -337 33, B_{21} 20 06, B_{31} 13.71, B_{41} 33 83, B_{51} 34 33,
λ 10^5

C_{111} 7000, C_{211} 5000, C_{311} 7000, C_{411} 10000, C_{511} 10500, C_{121} 6500, C_{221} 4500, C_{321} 6500,
C_{421} 9500, C_{521} 10000, C_{131} 6000, C_{231} 4000, C_{331} 6000, C_{431} 9000, C_{531} 9500

Table 3.Market demand and supply functions for existing producers[a]

Crop	Demand functions		Supply functions		Net demand curves	
	Price intercept	Slope	Cost intercept	Slope	Quantity intercept	Slope
	a_{ik}	b_{ik}	c_{ik}	d_{ik}	A_{ik}	B_{ik}
1	250	-0.003	-1,125	0.25	78,833	-337.33
2	300	-.05	-33,330	17.0	4,039	-20.06
3	400	-.08	-1,143	1.4	4,184	-13.21
4	250	-.03	-1,500	2.0	7,583	-33.83
5	300	-.03	-2,500	1.0	7,500	-34.33

[a]Prices are estimated in dollars per 1,000 pounds and quantities are in 1,000 pound units. In this example the demand and supply curves are linear.

Table 4. Production costs and yields by land class[a]

Crop	Production costs per acre C_{ijk}			Per acre yield Θ_{ij}		
	Land class 1	Land class 2	Land class 3	Land class 1	Land class 2	Land class 3
	Dollars			*1,000 lbs.*		
1	7,000	6,500	6,000	50	45	40
2	5,000	4,500	4,000	55	50	45
3	7,000	6,500	6,000	40	30	20
4	10,000	9,500	9,000	100	90	80
5	10,500	10,000	9,500	95	90	85

[a]In this example, land classes 1, 2, and 3 show progressively lower yields for all crops, but this progression is not a requirement of the program.

Table 5. Final acreages X_{ijk} for alternative problem solutions

Crop	Original iterative solution			Separable competitive solution			Separable monopoly solution		
	Land class 1	Land class 2	Land class 3	Land class 1	Land class 2	Land class 3	Land class 1	Land class 2	Land class 3
				Acres					
1	467.2	100.0	6.9	473.3	100.0	2.6	295.3	---	---
2	---	---	50.0	---	---	49.3	---	---	22.9
3	42.5	---	---	38.5	---	---	38.5	---	---
4	40.3	---	---	38.1	---	---	25.6	---	---
5	---	---	43.0	---	---	43.0	24.7	---	---
Total	550.0	100.0	100.0	550.0	100.0	94.9	384.1	---	22.9

Table 6. Equilibrium product prices and opportunity rents from alternative solutions

Crop	Equilibrium product prices			Land class	Opportunity rents		
	Iterative solution	Competitive solution	Monopoly solution		Iterative solution	Competitive solution	Monopoly solution
	Dollars				*Dollars*		
1	150.28	150.00	190.00	1	514.15	493.67	0
2	89.14	90.91	150.00	2	262.73	254.43	0
3	187.85	200.00	200.00	3	11.32	0	0
4	105.14	112.50	150.00				
5	111.90	111.77	150.00				

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APPENDIX

A simple single-market example appears below. Assuming that the cross elasticity between the demand for crop 1, q_{11} and the price, P_{21}, of crop 2 in market 1 is constant, the cross elasticity can be expressed as:

$$e_{12} = \frac{dq_{11}}{q_{11}} \Big/ \frac{dP_{21}}{P_{21}}$$

Rewrite as:

$$e_{12} \cdot \frac{dP_{21}}{P_{21}} = \frac{dq_{11}}{q_{11}}$$

The solution for this differential equation is:

$$q_{11} = \frac{q^{o}_{11}}{P^{o}_{21}}^{e_{12}} P_{21} \qquad \text{(a)}$$

Where q^{o}_{11} and P^{o}_{21} are the equilibrium (intersection of demand and supply) quantity and price on the market before the new project starts.

Since $Q_{11} = q_{11} - q^{o}_{11}$ (b)

equation (a) can be expressed as:

$$Q_{11} + q^{o}_{11} = \frac{q^{o}_{11}}{P^{o}_{11}}^{e_{12}} \cdot P_{21}$$

Substituting $\sum_j \Theta_{1j} X_{1j1}$ for Q_{11},

equation (b) becomes

$$\sum \Theta_{1j} X_{1j1} + q_{11} = \frac{q^O_{11}}{P^O_{21}} \quad P^{e12}_{21} \qquad \text{(c)}$$

Incorporating the cross-elasticity in the model means adding constraint (c). Since P^{e12}_{21} is a nonlinear term, linearization of P^{e12}_{21} is required. The procedures for linearization are those described in the text. To add a cross-elasticity constraint to figure 5 requires the addition of 1 column (Structural Variable) for P^{e12}_{21} and 2 rows—1 row for the cross-elasticity constraint and 1 for the functional equation. Additional grid equations and special variables employed in the linearization of P^2_{ik} can be used for the linearization of P^{e12}_{21}

RESEARCH REVIEW

Review of *Agricultural Economics Research*

It is habitual for a researcher to be objective about the problems of others. When he reflects on his own problems he is likely to fall into logical errors, overlook relevant data, succumb to preconceived biases, and/or react subjectively. Despite such risks, ERS organized a committee last year of seven researchers to reflect on the performance and future of our journal *Agricultural Economics Research*. The committee, chaired by Wayne Rasmussen, included Ben Blankenship, Tom Carlin, Bill Crosswhite, John Lee, Allen Paul, and J. B. Penn. As background for the committee's work, Penn reviewed progress of AER during its first 27 years. His report appears in this issue.

The committee recommended that ERS continue to publish AER and to carry high-quality articles reflecting the work of USDA's agricultural economists. It recommended that emphasis continue to be on technical articles and that articles reflect major research in the Department.

It was called to the attention of ERS last summer that people outside the Service sometimes do not have access to articles explaining various lines of ongoing research. For example, ERS has been developing models for short- and long-run forecasting. Some of these models are operational and are used as background for various reports and memoranda; others are in the developmental stage. Some are straightforward applications of textbook methods; others are innovative. The models include: shortrun forecasts of interactions among prices and quantities of agricultural commodities; an interface of the agricultural sector with an econometric model of the U.S. economy; a regional foreign trade forecast of prices and quantities; and a framework for longrun projections. In addition to these models of commercial agriculture, ERS is developing models for domestic river basins, slower growing rural areas, underdeveloped nations, and other economic problems. The committee's recommendation implies an admonition to put more information about this kind of research before the readers of AER.

This issue carries an article by Ray and Moriak explaining one of the above lines of research, POLYSIM. It carries an article by Huang and Hogg which uses an original way to estimate perfectly competitive equilibrium by constraining a linear program such that average revenue is compared with marginal cost. A book review by Jim Cavin reports on research using a technique known as "hierarchical interactions," a technique which might loosely be compared to stepwise nonlinear regression.

The committee abolished the book review section. When AER was new, few journals reviewed books of primary concern to our readers. Now most of the books we review are also reviewed in other journals to which our readers have access. Note that the chairman of the committee recommending this action has been AER's sole book review editor. His service to AER from January 1962 through October 1975 deserves recognition as the longest service of the 30 people to appear so far on the masthead. Second and third with the longest service are Ron Mighell and Elizabeth Lane.

A research review was proposed to replace the book reviews. The committee was clear that this new section might continue to contain book reviews but it will have a broader scope—brief review articles, reports on meetings and task forces, and various ideas of interest to USDA's agricultural economists. Thus, this issue carries, in addition to a book review, a review of a recent seminar on prime land including a look at research papers which served as background for that seminar, and a review of ERS involvement in providing information on multicounty districting. What the research review section might contain in the future depends on forthcoming interactions between you as readers and the editorial board.

Clark Edwards

Economic Growth and Social Equity in Developing Countries

By Irma Adelman and Cynthia Taft Morris. Stanford University Press, Stanford, Calif. 257 pages. 1973. $10.

In this important book, Professors Adelman and Morris treat the interactions of economic growth with a large number of economic, political, and sociocultural variables. The book contains the most recent in a series of original, exhaustive analyses for which the statistical seedbed comes from their earlier study *Society, Politics and Economic Development* (Johns Hopkins University Press, 1967).

The focus of the present study is on the conditions under which overall economic growth in developing countries is accompanied by gains in social equity. Two criteria for measuring such gains are "increased popular participation in the political process, and a more equitable distribution of income" (p. 1).

Contrary to anticipation, the expected gains have generally turned out to be losses. "Indeed, it has become clear that economic growth itself not only tends to be accompanied by actual declines in political participation but is one of the prime causes of income inequality" (pp. 1, 2). However, a handful of countries have achieved equitable growth, and their experience enables the authors to suggest some changes in development strategies that will link overall growth with social equity. This does not imply that they have formulated a new and comprehensive theory of economic growth. They make only the modest claim that their statistical findings "provide empirical foundations for subsequent theory construction" (p. 5).

The basic data for the study are 48 sociocultural, political, and economic indicators constructed for 74 countries. Only a few of these indicators are direct statistical estimates. Most are either proxies or purely qualitative constructions that are given a numerical score. An example of the former is the indicator of mass communication—a "composite index based on daily newspaper circulation and number of radio receivers" (p. 30). The statistical techniques employed are discriminant analysis for the political part of the study and hierarchial interactions for the income portion. For an explanation of these techniques, together with the more familiar factor analysis and canonical correlation, see the authors' "Analysis-of-Variance Techniques for the Study of Economic Development" *(J. Econ. Develpt. Stud.* 8, 1971, pp. 99-106).

The income analysis has several features. First, it is restricted to 43 countries where income data were available. Second, three independent variables were employed: the income share of the lowest 60 percent of the population; the middle quintile; and the wealthiest 5 percent. Third, relationships between each variable and the significant independent variables were determined for groups of 8-10 countries classified by relevant sociocultural, political, and economic characteristics. Fourth, the statistical method employed is hierarchial interactions—a technique rarely used by economists and encountered by me for the first time in this book. It cannot be described adequately in simple language, so a very general statement by the authors appears below:

> In spirit, it is akin to a highly nonlinear type of stepwise multiple regression analysis. Like stepwise regression the technique finds, at each step, those combinations of values of the independent variables that permit prediction of the value of the dependent variable with the least error. But unlike regression analysis, this branching process admits highly nonlinear interactions (p. 148).

The general procedure and statistical results are clearly brought out in three annotated charts (pp. 161-177) and summarized in table 2 (p. 184). The six most important variables "associated with inter-country differences in patterns of income distribution, as judged by frequency of significance, are rate of improvement in human resources, direct government economic activity, socio-economic dualism, potential for economic development, per capita GNP, and strength of the labor movement" (p. 183). Other variables, such as abundance of natural resources, structure of foreign trade, and nature of agricultural organization enter the picture in certain instances.

General conclusions about the factors affecting the distribution of income in developing countries are rather difficult to make, as significant conclusions appear in almost every chapter. The following paragraph on development strategies must suffice:

> Inequality of income tends to be greatest where the exploitation of an abundance of natural resources coincides with a concentration of assets in the hands of expatriates; it tends to be least where development strategies stress investment in human resources, greater diversity of manufacturing exports, and expansion of public sector output and investment. In short, our analysis supports the Marxian view that economic structure, not level of income or rate of economic growth, is the basic determinant of patterns of income distribution (p. 186).

In preparing this review, I have benefited from Professor Adelman's summary of the book which appeared as "Strategies for Equitable Growth" in the May/June 1975 issue of the magazine *Challenge*. In the article, the conslusions concerning the relationship between growth in the GNP of a country and equity in the distribution of income should be of wide interest. In general, the annual growth rate of the GNP should be at least 5.5 percent for growth to be equitable. This condition, though necessary, is not sufficient:

> High growth rates tend to benefit the poorest 40 percent of the population only when accompanied by a strategy emphasizing educational development, and only when not sharply dualistic, that is, when it does not stress the modern industrial sector to the exclusion of the traditional agrarian sector (p. 41).

Also in the article, Adelman cites five noncommunist countries (Israel, Japan, South Korea, Singapore, and Taiwan) "that have successfully combined accelerated growth with improvements in the share of the income accruing to the poor." She gives an especially good summary of the strategies used in South Korea, which was not among the countries statistically analyzed in the book.

As has been noted elsewhere, the outlook for the developing countries is beclouded by the energy situation, the prospect of recurrent world food shortages, and the nature of the accommodation of Western countries to the demands of the Third World. Nevertheless, any country that has launched or will begin a program of economic growth aimed at improvement of the economic condition of all its people will find lessons in the Adelman-Morris study that cannot be ignored.

James P. Cavin

New Stimulants for Land Use Research

The use of land is a complex topic and has emerged as a high-priority national issue. To inform policymakers and to explore the implications of this issue for agricultural and forest land policy, the USDA Committee on Land Use (established by the Secretary of Agriculture in 1973) recently sponsored a "Seminar on the Retention of Prime Lands." A set of background papers *Perspectives on Prime Lands* served as a catalyst for discussion at the seminar.[1] A few observations on this activity and its research implications seem worth mentioning, particularly in light of the extent to which the research community has neglected land use policy as a focus of inquiry. Witness the intensity of recent action at the State and local level with little more basis for decision-making than intuition and rhetoric.

This seminar provided a greatly needed forum for reflecting on the relationship between food and fiber production and land use planning and policy. Participants in the seminar came from groups that seldom exchange views on substantive issues—U.S. Congressional staff members, planners from State government offices, representatives of environmental groups, State Departments of Agriculture, the League of Women Voters, the Council of State Governments, research foundations, the U.S. Department of the Interior, the Council on Environmental Quality, the American Society of Planning Officials, the National Association of Conservation Districts and the Oak Ridge National Laboratory. In addition, economists, agronomists, planners, soil scientists, foresters, and political scientists from land grant universities and USDA were in attendance.

The background papers and reviews provide a thought-provoking overview of the case for retention of prime agricultural and forest lands. Four of the nine papers focused on assessments of the adequacy of the land resource base to meet future food and fiber demands; three on defining and classifying prime and unique lands; and two on the difficulties of designing and implementing public policy to retain land in agricultural, forest, recreation, and other nonurban uses. Each paper had four reviews, most of which contained penetrating, well-articulated insights.

The central theme of the seminar evoked considerable controversy: Should efforts be undertaken to retain prime or critical agricultural, forest, or other open-space lands? The disagreement concerned our current ability to justify the retention of prime lands. Recognition of major differences in the background and perspectives of the participants is important in understanding and reconciling their divergent positions. Persons with a national perspective, who perceive food and fiber production as the most important objective for retention of prime lands, generally tended to be among the least convinced as to the urgency of efforts to retain productive or critical agricultural, forest, and other open-space lands. The evidence available indicates that the U.S. land resource base will be adequate to meet projected domestic and foreign food and fiber demands beyond the year 2000.

Those viewing the situation from the State or local perspective, however, more vociferously supported prime lands retention. It was argued that important land use shifts may be masked by aggregate national time series data on the allocation of land between uses. From the State or local perspective, rural land use objectives other than food and fiber production are clearly important—containment of suburban sprawl, aesthetics, recreation, and the contribution of agriculture and its supporting industries to the vitality and diversity of the state or local economy. The breadth and depth of support for this perspective is evident in the numerous recent State and local efforts to reduce the conversion of rural lands to urban/suburban uses.

Most participants agreed on one point; physical criteria alone are an inadequate basis for classifying land as prime or critical. Many nonphysical criteria were suggested, such as efficiency in use of inputs, location, existence of agricultural infrastructure, ownership, level of nonmarket demand (for recreation, wildlife habitat, and so on), and presence of hazardous conditions. The incorporation of nonphysical criteria would add a new dimension of efficacy as well as complexity to land inventory efforts. An inventory of prime lands based on economic and environmental criteria as well as physical criteria would be a major undertaking. Nationally consistent data on soils, their economic productivity and energy requirements in production would be useful in identifying prime lands.

A brief comment on semantics—I believe there would be increased support for a public policy position on prime or critical lands if the term "conservation" were substituted for "retention" or "preservation." Preservation, in particular, is too inflexible a concept. A policy of prime or critical lands conservation would implicitly acknowledge that the public interest might best be served by high-rise development on cropland under one set of circumstances and cropland preservation in another. A national policy of prime or critical lands conservation would advocate that State and local governments undertake efforts to limit the conversion of critical agricultural, forest, and open-space lands to other uses; that conversion should be by deliberate choice rather than by default; and that decisions be made more public.

Post-seminar assessments of the research implications of the background papers and seminar debates have been completed.[2] In general, the seminar reflects the breadth

[1] U.S. Department of Agriculture. *Perspectives on Prime Lands*. Background papers for Seminar on Retention of Prime Lands, July 16-17, 1975, sponsored by the USDA Committee on Land Use. Washington, D. C.

[2] U.S. Department of Agriculture. *Recommendations on Prime Lands*. A Follow-up Report on the Prime Lands Seminar. Washington, D.C. (forthcoming).

of support for increased research and technical assistance to identify land use options and the impacts of land use change. Research recommendations of particular interest to economists include:

- Identify the impacts of increased energy prices, greater competition for water, and increased environmental regulation on the use of agricultural and forest lands.
- Evaluate the effectiveness of alternative land use control techniques. Devote special attention to evaluation of farmland conservation programs already implemented.
- Determine the impact of tax policies—Federal, State, and local—on the allocation of land between uses.
- Develop feasible methods of integrating economic and social criteria into land classification systems.
- Evaluate the rates and consequences of conversion of prime lands to nonagricultural uses.
- Intensify efforts to increase the productivity of land in agricultural and forest uses.

Another important new document which makes the case for land use research is the recent report of the National Task Force on Research Related to Land Use Planning and Policy.[3] This report, directed at those who influence the allocation of research resources, is also useful to individual researchers. Important land use planning and policy issues are identified, and nearly 100 research recommendations are specified. This report complements *Perspectives on Prime Lands* and I recommend it to those interested in land use research.

Greg Gustafson

A Short History of the Development District Information System

In view of the rapid expansion of multicounty planning and development districts since 1965, the Development District Information System (DDIS) was established by the Area Analysis Branch of ERS in November 1969. The initial intention was to keep comprehensive records of every multicounty district in the United States, especially for staffing, funding, and programs undertaken by the district or its governing agency. Districts were to be (1) multicounty, (2) multipurpose, and (3) nationwide. Only those that could be formed anywhere in the United States were to be included. This last requirement ruled out a large number of multicounty, multipurpose districts, such as the Local Development Districts of the Appalachian Regional Commission. The districts included were: (1) Substate Planning and Development Districts, (2) Councils of Governments, (3) Economic Development Districts, (4) Resource Conservation and Development Project Areas, and (5) Nonmetropolitan HUD-Funded Districts.

TYPES OF MULTICOUNTY DISTRICTS

Substate Planning and Development Districts are created by the States by specific legislation, by executive order, or, in some States, by both methods. Substate districting is a fairly recent innovation. In 1966 there were, by the count of the Advisory Commission on Intergovernmental Relations (ACIR), 53 substate districts in four States. Today there are 549 such districts in 44 States.

Actions of the Federal Government in the middle and late 1960's provided the impetus for substate districting on a broad scale. In 1965, two laws were enacted which affected the delineation of substate districts: the Public Works and Economic Development Act and the Appalachian Regional Development Act. The former law authorized creation of the Economic Development Districts (discussed below) and the latter, the Local Development Districts. Both Acts provided financial aid, as well as planning and technical assistance, to areas experiencing high unemployment, outmigration, or low income.

The importance of these Federal laws on later substate districting was twofold. First and most importantly, some Federal and State officials began to think of multicounty areas as the focus of comprehensive economic development efforts. From there it was a short step to envision a district organization operating within such an area which could do economic planning and coordinate Federal programs. Second, the experience of establishing Economic Development Districts and Local Development Districts gave some State officials practical experience in the delineation of multicounty planning and development districts. Those States which delineated a large number of either type of district in the mid-1960's generally used that experience later when they named official substate districts.

In 1968, two additional acts which had a significant influence on substate districting were passed: the Housing and Urban Development Act and the Intergovernmental Cooperation Act. The first Act extended "701" comprehensive planning grants, earlier available only to metropolitan planning bodies, to State planning agencies to assist district planning bodies in nonmetropolitan areas. The widespread availability of planning grants brought about the creation of a large number of substate districts which would be eligible to apply for the funds.

The other 1968 Act established a statutory basis for extending the review and comment procedure of an earlier law (The Demonstration Cities Act of 1966) to nonmetropolitan planning districts. Regulations issued to implement the Act (culminating in OMB Circular No. A-95) authorized the establishment of State and regional "clearinghouses" to review applications for

[3] National Task Force on Research Related to Land Use Planning and Policy. *Land Use: Issues and Research Needs for Planning, Policy and Allocation*. Washington, D.C., 1976.

approximately 100 Federal and federally assisted grant programs.

The Federal Government provided incentive for the creation of substate planning and development districts on the part of the States in three ways. It gave an impetus for the formation of Economic Development Districts and Local Development Districts, the first widespread effort at nonmetropolitan multicounty, multipurpose regionalization. It made HUD's comprehensive planning grants available to substate districts upon their formation. Lastly, the Government offered the governor and local officials a "piece of the action" where Federal programs were concerned, through the "review and comment" procedures outlined by OMB Circular No. A-95. Their involvement hinged on the States' establishment of substate organizations.

Councils of Governments (COG), a second type of district, are voluntary associations of local governments whose governing boards consist of a majority of elected officials or their representatives. A COG may be established under a specific State enabling statute or a local agreement to coordinate planning and other programs affecting the jurisdictions involved. Many of these bodies are interstate, particularly those in large metropolitan areas. In a few States, such as Texas, Oregon, and South Carolina, the Councils of Governments and the official Substate Planning and Development Districts are virtually the same. The Substate Planning and Development Districts are little more than geographical boundaries while the Councils of Governments are officially recognized agencies which act as the planning and development organization within the substate districts.

Economic Development Districts are multicounty districts designated by the Economic Development Administration of the U.S. Department of Commerce, under Public Law 89-136 (the Public Works and Economic Development Act of 1965), after consultation with State and local officials. Planning and development for each district is conducted through a nonprofit corporation consisting of local citizen leaders and government officials representing major economic, social, and government interests in the area. An Economic Development District may be created when portions of the area in which it is located meet Federal Government criteria such as high unemployment, high rate of outmigration, or low median family income. The boundaries of the district must be agreed upon by the governor of the State involved and officials of the Economic Development Administration. In some States, the Economic Development Districts are coterminous with the official Substate Planning and Development Districts. In those areas where the same staff serves both types of district, the Economic Development District and the Substate Planning and Development District are virtually the same entity. However, a large number of the Economic Development Districts are completely separate organizations.

The *Resource Conservation and Development Project Areas* are created by USDA's Soil Conservation Service under Public Law 87-703, the Food and Agriculture Act of 1962. Resource Conservation and Development Project Areas are organized and directed by local citizens and public officials to promote conservation and resource development.

The fifth and last category of district is the *Nonmetropolitan HUD-Funded District*. The U.S. Department of Housing and Urban Development (HUD) targets its "701" funds to existing districts. The DDIS record simply notes the amount of such funds which go to a Substate Planning and Development District, a Council of Governments, an Economic Development District, or a Resource Conservation and Development District. When a multicounty district not included in the above classification was funded, it was included in the DDIS record.

ACCOMPLISHMENTS OF DDIS

DDIS was responsible for two documents which proved to be helpful both within and outside the Department of Agriculture. These are (1) the map entitled "Substate Planning and Development Districts," and (2) the looseleaf volume released in 1973, "Status of Multi-County Development Districts." The map covered only the Substate Planning and Development Districts. First issued October 1, 1970, the map appeared in updated form biannually until March 1974. The looseleaf volume was a collection of 50 separate State reports, each varying in length from one to eight pages. These reports covered all five types of districts included in DDIS.

RECENT DEVELOPMENTS

The pace of formation of new districts and changes in boundaries of existing districts has slackened considerably, so the DDIS program has been sharply curtailed. ERS plans to maintain a file of district boundaries to update periodically to provide information for other research projects. There are no plans now for regular publications of the type formerly produced.

The important questions have changed from monitoring expansion in districting to analysis of the capabilities and operations of existing multicounty districts. For example, some rural-oriented multicounty districts appear to be providing specialized staff support. Too little is known of the extent of these activities or of the capabilities of rural districts to provide such help. Multicounty districts are often seen as a source of coordination among units of government within a region, but scant information is available on their success in doing so. Multicounty districts are frequently considered as potential delivery agents for various rural development programs, but knowledge of their delivery capabilities is lacking. These districts appear to represent a fruitful area for additional research.

Robert C. Peak

Suggestions for Submitting Manuscripts for
Agricultural Economics Research

Contributors can expedite reviewing and printing of their papers by doing these things:

1. SOURCE. Indicate in a memorandum how the material submitted is related to the economic research program of the U.S. Department of Agriculture and its cooperating agencies. State your own connection with the program.
2. CLEARANCE. Obtain any approval required in your own agency or institution before sending your manuscript to one of the editors of *Agricultural Economics Research*. Attach a copy of such approval to the manuscript.
3. ABSTRACT. Include an abstract and at least three keywords when you submit your article. The abstract should not exceed 100 words.
4. NUMBER OF COPIES. Submit three good copies.
5. TYPING. Double space everything, including abstract and footnotes.
6. FOOTNOTES. Number consecutively throughout the paper.
7. REFERENCES. Check all references carefully for accuracy and completeness.
8. CHARTS AND OTHER ARTWORK. Use charts sparingly for best effect. Keep design as simple as possible to improve communication. Submit all artwork in draft rather than final form, accompanied by neatly prepared pages with essential data for replotting. Complex or detailed charts and other artwork are usually best suited to full page or 2 page treatment (final image size will be 6-5/8" x 4-3/8"). Simpler charts should be designed to fit half page (final image size of 6-5/8" x 4-3/8") or quarter page (final image size of 3-3/8" x 4-3/8").
9. FINAL TYPING. Two good copies, double spaced, will be required of final copies of edited and revised manuscripts accepted for publication.

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